Fort Thomas Independent Schools
Curriculum Guide
For

Science
Grades K-12

Summer 2001

Fort Thomas Independent Schools
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This document is also available on the district's web site at
http://ft-thomas.k12.ky.us/curricul.htm

FORT THOMAS INDEPENDENT SCHOOLS

Science Curriculum
Development Committee
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Fort Thomas Independent Schools
Science Curriculum
Introduction and General Overview

As directed by the Fort Thomas Independent Schools Strategic Plan, a committee of K-12 content specialists have formulated a science curriculum guide, which is aligned to Kentucky's *Academic Expectations*, *Program of Studies* and *Core Content for Assessment*. National Standards and tenets from *Best Practices* were also considered in the development of this document.

Goals were identified and serve as the foundation for all science courses in the Fort Thomas Independent School district. Our desire is to enable students to:

- Scientific Inquiry
- Content Knowledge
- Curiosity
- Communication
- Application

Through teaching science daily in K-8 and requiring three high school credits in the discipline, Fort Thomas Independent School students will be afforded the opportunity to meet the goals as outlined by the alignment committee.

The following chart is a continuum of the goals identified by the curriculum committee. This diagram serves as an outline of the exit criteria of the goals by grade levels. In essence, these are affective statements, which describe what we, as educators, want our students to be like.

	Primary **EL – P3**	**Intermediate Grades 4 – 5**	**Middle Grades 6 – 8**	**High School Grades 9 – 12**
Scientific Inquiry	Students will be able to ask questions about objects, organisms and events in their environment.	Students will ask a question about the environment and plan and conduct a simple investigation which employs simple equipment and tools to gather data from which they will communicate a reasonable explanation.	Students will be able to explore scientific concepts using various forms of inquiry such as hands-on activities, demonstrations, research and discussions.	Students will be able to identify pertinent factors of a problem, design and carry out an experiment, analyze data and communicate results.
Content Knowledge	Students will begin to develop an understanding of physical science, life science and earth/space science.	Students will observe and manipulate objects in the environment, experience concepts of living things, and identify properties and trends of earth/space science.	Students will be able to understand and continue to build upon their previous knowledge of earth, life and physical science.	Students will demonstrate, via application, analysis, synthesis and evaluation, knowledge of physical science, life science, earth science and space science.
Curiosity	Students will begin to develop a natural curiosity about science in their community.	Students will broaden their curiosity about science in their environments.	Students will be encouraged to expand a general curiosity about the scientific world around them.	Students will be encouraged to develop and maintain a high interest in science.
Communication	Students will begin to communicate about their scientific observations using reports, tables, graphs, charts, technology, etc.	Students will further develop observation and description skills ad communicate using tables, graphs, charts, technology.	Students will be able to express scientific knowledge and concepts using many different mediums.	Students will be able to effectively communicate scientific content to a variety of audiences using current technologies for a variety of purposes.
Application	Students will begin to apply scientific knowledge to their known experiences.	Students will continue to apply scientific concepts to real-life situations and experiences.	Students will be able to apply scientific knowledge in order to accomplish several arithmetic tasks such as solving real-life problems.	Students will be able to connect scientific principles to everyday situations.

In order to reach our goals for Fort Thomas Independent Schools' students, we believe that an integrated science curriculum is essential. In all courses, the following three strands are integrated:

- Life Science
- Physical Science
- Earth Science

Grade	Life	Earth	Physical
K	Animals and their Needs	Taking Care of the Earth Seasons and Weather	Magnetism
1	Habitats	Properties of the Earth's Materials Intro to Solar System	Properties of Matter Light and Heat
2	Organisms (Animals)	Solar System	Magnetism Electricity
3	Organisms (Plants)	Weather Water Cycle Pollution/Conservation	Electricity Simple Machines
4	Characteristics of Organisms Life Cycle of Organisms Organisms and Environment	Properties of Earth's Materials Objects in the Sky Changes in Earth and Sky	Properties of Objects and Materials Position and Motion of Objects Light, Heat, Electricity and Magnetism
5	Cells	Structure of Earth's System	Transfer of Energy Motion and Forces Properties and Changes of Properties of Matter
6		Rocks and Minerals Changing Surface of the Earth Earth's Atmosphere and Weather Earth's Layers and Landforms Earth's History Earth in the Solar System	
7	Scientific Inquiry/Characteristics of Living Things Ecology Cytology Heredity Evolution Survey of Kingdoms Taxonomy Viruses, Monerans & Protists Fungi Plants Invertebrates		

Grade	Life	Earth	Physical
8			Scientific Method and Measurement States of Matter Classification of Matter Elements and Atoms Compounds and Chemical Bonds Chemical Reactions Water and Solutions
9 **Physics**		Plate Techtonics Currents Waves (Seismic)	Physical Science Basics Motion Energy Waves, Light, and Sound Electricity and Energy Resources
10 **Biology**	Science Inquiry Ecology Biochemistry The Cell Energy and Cells Genetics Evolution Taxonomy/Classification Life Survey		
11 **Chemistry**		Earth/Space	**A. Chemistry I** Measurement/Calculations Atomic Structure and Nuclear Reactions Classification and Properties of Matter Electron Configuration and Periodic Table Formula Mass, Formulas, Naming, Types of The Mole, Solutions, and Gas Laws Chemical Reactions and Stoichiometry Thermochemistry and Calorimetry Equilibrium, Kinetics and Antrophy **B. Chemcom** Earth & Space Petroleum Materials: Structure and Uses Air Water

Primary Science Curriculum
Grades Kindergarten to Three

Description

Primary level science will focus on the Life, Physical, and Earth and Space sciences. The K-2 curricula is intended to help establish a broad background of knowledge for students in preparation for the third grade. The third and fourth grade curricula are designed to prepare students for the fourth grade assessment test. Students will gain skills in Communication, Technology, Outdoor Education, and Higher Level Thinking. These learning experiences will also enhance the students' natural curiosity of science and empower them to explore science in their everyday lives. All science instruction should use an inquiry approach since it is researched-based and reflected in our state assessment.

Units	K	1	2	3
Life Science	Animals and Their Needs	Habitats	Organisms (Animals)	Organisms (Plants)
Earth Science	Seasons and Weather Taking Care of the Earth	Properties of Earth Materials Solar System (Introduction)	Solar System	Weather Water Cycle Pollution and Conservation
Physical Science	Properties of Matter Magnetism	Properties of Matter Light and Heat	Magnetism Electricity (Introduction)	Electricity Simple Machines

Course Questions

To achieve our goals, the following questions were designed to be considered throughout primary school.

A. How does science affect your everyday life?
B. How would you gather and report information about science?

The following standards are taught in all units:

- Ask simple scientific questions that can be answered through observations.

Ask simple scientific questions that can be investigated through observations combined with scientific information.

- *Use simple equipment (e.g., aquariums), tools (e.g., magnifiers, spoons), skills (e.g., observing, pouring), technology (e.g., video discs), and mathematics in scientific investigations.*

Use simple equipment (e.g., magnifiers, magnets), tools (e.g., metric rulers, thermometers), skills (e.g., classifying, predicting), technology (e.g., electronic media, calculators, World Wide Web), and mathematics in scientific investigations.

- *Use evidence (e.g., observations) from simple scientific investigations and scientific knowledge to develop reasonable explanations.*

Use evidence (e.g., observations, data) from simple scientific investigations and scientific knowledge to develop reasonable explanations.

- *Design and conduct different kinds of simple scientific investigations.*
  Design and conduct simple scientific investigations.
- Communicate (e.g., draw, graph, write) designs, procedures and results of scientific investigations.

Communicate (e.g., draw, graph, write) designs, procedures, observations, and results of scientific investigations.

- Question scientific investigations and explanations of other students.

Review and ask questions about scientific investigations and explanations of other students.

- *Distinguish between natural objects and objects made by humans.*

Distinguish between natural objects and objects made by humans and examine the interaction between science and technology. Technology (e.g., thermometer, hand lens) is used to study science, while science provides theories for technology. Science is used to design simple technological solutions to problems (e.g., use understanding of heat and transfer in designing an insulated container for ice cubes).

- *Examine the interaction between science and technology.*

Distinguish between natural objects and objects made by humans and examine the interaction between science and technology. Technology (e.g., thermometer, hand lens) is used to study science, while science provides theories for technology. Science is used to design simple technological solutions to problems (e.g., use understanding of heat and transfer in designing an insulated container for ice cubes).

- *Recognize how science helps to understand characteristics of (e.g., density, size) and changes in populations.*

Examine how designing and conducting scientific investigations fosters an understanding of issues related to natural resources (e.g., scarcity), demonstrate how the study of science (e.g., aquariums, living systems) helps explain changes in environments, and examine the role of science and technology in communities (e.g., location of landfills, new housing developments).

- *Examine how science fosters understanding of issues (e.g., use/misuse, availability, distribution) related to natural resources.*
- *Demonstrate how the study of science (e.g., ecology, chemistry) helps explain changes in environments (e.g., pollution).*

Examine the role science plays in everyday life.

Course/Grade K **Unit: Earth & Space Science:** *Seasons and Weather* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How does Earth and space science affect your everyday life? 2. How would you gather and report information about Earth and space science?	• The Sun provides the light and heat necessary to maintain the temperature of the Earth. *The Sun provides the light and heat necessary to maintain the temperature of Earth. The Sun's light and heat are necessary to sustain life on Earth.* • Weather changes from day to day and over seasons. *The surface of the Earth changes. Some changes are due to slow processes such as erosion or weathering. Some changes are due to rapid processes such as landslides, volcanic eruptions, and earthquakes.* *Weather can change from day to day over the seasons. Weather can be described by observations and measurable quantities, such as temperature, wind direction and speed, and precipitation.*	• The four seasons • Characteristics of local weather patterns during the different seasons • The sun: source of light and warmth • Daily weather changes – Temperature: thermometers are used to measure temperature – Clouds – Rainfall: how the condition of the ground varies with rainfall; rainbow – Thunderstorms lightning and thunder, hail, safety during thunderstorms – Snow and snowflakes, blizzard	*Students will:* • Play Four Seasons Lotto (commercially made game). • Paint a picture of a deciduous tree in each season and label. • Incorporate weather terminology at calendar time. • Take the outside temperature and inside temperature. Discuss why they are different. • Take the temperature in the morning and afternoon. Discuss why they are different. • Draw a water cycle. • Make rain by doing an experiment. Pour warm water into one glass jar about 1/3 full and cold water into another jar. Place a plastic bag of ice cubes into pie pans and put on top of the jars. • Write a poem describing a weather word. (WP Literary) • Use the Internet to research local, national, and world weather patterns. • Choose a tree and photograph it in each season. Discuss the changes.

Course/Grade K **Unit: Earth and Space Science:** *Taking Care of the Earth* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How does Earth and space science affect your everyday life? 2. How would you gather and report information about Earth and space science?	• Earth's materials are solids (e.g., rocks, soils), water (e.g., oceans), and gases (e.g., oxygen). *Earth materials provide many of the resources humans' use. The varied materials have different physical and chemical properties, which make them useful in different ways, for example, as building materials (e.g., stone, clay, marble), as sources of fuel (e.g., petroleum, natural gas), or growing the plants we use as food.* • *Earth materials are solid rocks and soils, water, and the gases of the atmosphere. Minerals that make up rocks have properties of color, texture, hardness. Soils have properties of color, texture, the capacity of retain water, and the ability to support plant growth. Water on the Earth and in the atmosphere can be a solid, Liquid or gas.*	• Conservation: Some natural resources are limited, so people must be careful not to use too much of them (e.g., logging and reforestation). • Practical measures for conserving energy and resources (e.g., turning of lights, tightly turning off faucets, etc.) • Some materials can be recycled (e.g., aluminum, glass, paper) • Pollution (e.g., littering, smog, and water pollution) can be harmful, but if people are careful they can help reduce pollution.	*Students will:* • Brainstorm ways to save the Earth (e.g. take showers instead of baths, turn off unused lights, turn off water while brushing teeth, use both sides of your paper, pick up litter.). • Make recycled bird feeders out of clean half-gallon milk cartons. Cut a window in one or two sides of the carton. Cut a hole on each side of the carton about 3/4 of the way down. Slide a dowel rod through the holes. Punch two holes through the top roof of the carton. Thread string or yarn through the holes to hang. Put birdseed in the bottom of the feeder and hang it up outside. • Sort objects in the classroom recycle box. Make a graph to represent the contents. • Pick up litter on the playground. • Plant a tree in the schoolyard. (Outdoor Education) • Make recycled paper. Soak old newspaper overnight in bucket. Drain the water. Mash up the paper with hands in the bucket. Add water to paper to make a mushy pulp. Using hands spread an even layer of the pulp on a wire mesh and let dry. Carefully remove and use paper.

Course/Grade K **Unit: Life Science:** *Animals and Their Needs* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How does life science affect your everyday life? 2. How would you gather and report information about life science?	• Organisms have basic needs and can only survive when these needs are met. *Organisms have basic. For example, animals need air water, and food; plants need air, water, nutrients, and light. Organisms can survive only in environments in which their needs can be met.* • Behavior of individual organisms is influenced by stimuli. • Organisms have different structures that serve different functions. These structures are used to sort organisms into groups. *Things in the environment are classified as living, nonliving and once living. Living things differ from nonliving things. Organisms can survive only in environments in which their needs can be met.* *Each plant or animal has structures that serve different functions in growth, survival, and reproduction. For example, humans have distinct body structures for walking, holding, seeing and talking.* • Organisms resemble their parents. *Plants and animals closely resemble their parents at some time in their life cycle. Some characteristics (e.g., the color of flowers, the number of appendages) are passed to offspring. Other characteristics are learned from interactions with the environment such as the ability to ride a bicycle, and these cannot be passed on to the next generation.* • Organisms have life cycles that are different for different organisms. *Plants and animals have life cycles that include the beginning of life, growth and development, reproduction and death. The details of a life cycle are different for different organisms.* • All animals depend on plants for food. *Plants make their own food. All animals depend on plants. Some animals eat plants for food. Other animals eat animals that eat the plants.*	• Animals need food, water, and space to live and grow. • Offspring are very much (but not exactly) like their parents. • Most animal babies need to be fed and cared for by their parents: human babies are especially in need of care when young. • Pets have special needs and must be cared for by their owners.	*Students will:* • Conduct an experiment to conclude what animals need. Fill a jar with alternating layers of sand and soil. Punch holes into the lid. Place vegetable scrapings in the jar and sprinkle with water. Put in two earthworms. Keep the jar away from light. Make predictions about what the earthworms will do. Put food and spray with water daily. Draw a picture of the jar. Observe the worms for a week. Draw a picture of the jar on the last day. • Cut out pictures of animals and match with offspring. • View a video on mammals and how they take care of their young. • Observe a classroom animal for example a hamster, fish aquarium, gerbil, or turtle. Discuss what the animal needs to survive and the class' responsibility as the owner of the class pet. • Make a booklet and illustrate animals and their needs. (WP Transactive piece) • Research animals and their needs on the Internet field trip to zoo or farm

Course/Grade K **Unit: Physical Science:** *Magnetism* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How does physical science affect your everyday life? 2. How would you gather and report information about physical science?	• Properties (e.g., size, shape) of materials can be measured and used to describe, separate, or sort objects. *Objects have many observable properties such as size, mass, shape, color, temperature, magnetism, and the ability to react with other substances. Some properties can be measured using tools such as metric rulers, balances and thermometers.* • The position and motion of an object can be changed by pushing or pulling. *The position and motion of objects can be changed by pushing or pulling. The amount of the change in position and motion is related to the strength of the push or pull force. The force with which a ball is hit illustrated this principle.* • Magnets attract and repel each other as well as certain kinds of other materials. *Magnets attract and repel each other, and magnets attract certain kinds of other materials (e.g., iron).*	• Magnetism demonstrates that there are forces we cannot see that act upon objects. • Most magnets contain iron. • Magnetic poles are north-seeking and south-seeking poles • Magnetic fields are strongest at the poles. • The law of magnetic attraction is that unlike poles attract and like poles repel. The earth behaves as if it were a huge magnet: north and south magnetic poles. (They are near but not the same as, geographic North Pole and South Pole.)	*Students will:* • Test objects with a magnet to determine which of the objects can be attracted by the magnet. • Discuss the properties of objects that are attracted to magnets. • Use a compass and show how the compass needle is attracted to the north part of the compass just as metal objects are attracted to magnets. • Brainstorm how magnets are used in real life.

Course/Grade 1st **Unit: Earth and Space Science:** *Properties of the Earth* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How does earth and space science affect your everyday life? 2. How would you gather and report information about earth and space science?	• Earth's materials are solids (e.g., rocks, soils), water (e.g., oceans), and gases (E.g., oxygen) • *Earth materials include solid rocks and soils, water, and the gases of the atmosphere. Minerals that make up rocks have properties of color, texture, and hardness. Soils have properties of color, texture, the capacity to retain water, and the ability to support plant growth. Water on Earth and in the atmosphere can be a solid, liquid, or gas.* • *Earth materials provide many of the resources humans use. The varied materials have different physical and chemical properties, which make them useful in different ways, for example, as building materials (e.g., stone, clay, marble), as sources of fuel (e.g., petroleum, natural gas), or growing the plants we use as food.* • Fossils provide evidence about organisms that lived long ago. *Fossils found in Earth materials provide evidence about organisms that lived long ago and the nature of the environment at that time.*	• The Earth's Surface. – The shape of the earth, the horizon. – Oceans and continents – North Pole and South Pole, Equator. • What's inside the Earth – Inside the Earth – Layers: crust, mantle, core – High Temperatures – Volcanoes and geysers – Rocks and minerals – (Formation and characteristics of different kinds of rocks: metamorphic, igneous, sedimentary and important minerals in the earth such as quartz, gold , sulfur, coal, diamond, iron ore, fossils)	*Students will:* • Review basic information about the earth (shape) • Introduce key vocabulary (North Pole, South Pole, Equator, Ocean and Continent). • In cooperative groups, they will paint an earth model. The Oceans will be painted blue, Continents green, Equator Red and the Poles purple. • Read *Magic School Bus Inside the Earth*, by Cole. • Using a peach to represent the earth, they will demonstrate the core of the earth by cutting into the peach and showing the seed. (teacher safety) Afterwards, they will refer back to the peach to show the layer below the skin. This will represent the mantle of the earth. • Using an apple to represent the earth, they will observe an adult peeling the skin to demonstrate the crust of the earth. • Create a model of the earth using red, yellow and blue play-doh. They will make a red ball (1/2 inch in diameter) to represent the core. Cover the red ball with a thick layer of yellow play-doh to represent the mantle. Cover the mantle with a thin layer of blue to represent the crust. They will then poke a clear straw through their earth to show the layers. • *Be introduced to new vocabulary (Volcanoes, Mountains)* • In cooperative groups, conduct a volcano model experiment using a 16-oz container, funnel, baking soda, vinegar, red food coloring, sand and a cake pan. • Display rocks and discuss similarities and differences. • Sort rocks do similarities and differences. • Make a sedimentary rock model. Break open the model to demonstrate the fossils inside. • In small groups compare their sedimentary rock with a pumice stone (example of igneous rock) given by the teacher. They will share their findings with the class. • Make crystals. (Crystals on a pillar- Mix 2 Tbs. Of rock salt with 1 cup hot water in a clear plastic cup. Tie a piece of string and yarn to a pencil so that they are in the water. Place in sun and make observations.)

Course/Grade 1st **Unit: Earth and Space Science:** *Introduction to the Solar System* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How does earth and space science affect your everyday life? 2. How would you gather and report information about earth and space science?	• The Sun provides the light and heat necessary to maintain the temperature of the Earth. *The Sun provides the light and heat necessary to maintain the temperature of the Earth. The Sun's light and heat are necessary to sustain life on Earth.* • Common objects in the sky (e.g., stars, clouds, airplanes) have properties, locations, and movements that can be observed and described. *Objects in the sky (e.g., Sun, clouds, moon) have properties, locations, and real or apparent movements that can be observed and described.* • Objects in the sky (e.g., Sun, moon) have patterns of movement. *Changes in movement of objects in the sky have patterns that can be observed and described. The Sun appears to move across the sky in the same way every day, but the Sun's apparent path changes over seasons. The moon moves across the sky on a daily basis much like the Sun. The observable shape of the moon changes from day to day in a cycle that lasts about a month.* • Weather changes from day to day over the seasons. *The surface of the Earth changes. Some changes are due to slow processes such as erosion or weathering. Some changes are due to rapid processes such as landslides, volcanic eruptions, and earthquakes.*	• Sun: source of energy, light, heat • Moon: phases of the moon (full, half, crescent, new) • The nine planets (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto) • Stars • Constellations, Big Dipper • The sun is a star. • Earth and its place in the solar system • The earth moves around the sun; the sun does not move. • The earth revolves (spins); one revolution takes one day (24 hours). • Sunrise and sunset • When it is day where you are, it is night for people on the opposite side of the earth.	*Students will:* • Using a flashlight, globe and paper tent, they will demonstrate how the light lights the earth and show what happens as the earth rotates. Show how the paper tent casts a shadow on the globe as it rotates. • Conduct sun/heat experiments. Predict and record what happens when ice is left in the sun. List thing that should be left in the sun or in the shade. • Create a moonscape, using clay, sand, rocks and paint. • Compare the earth's surface with the moon's surface. • Create a Moon Chart. Show the moons in this order (full, half, crescent, new) • Using various means, they will each research one of the nine planets. They will report to the class and they will be videotaped, in order to review at end of the unit. (Technology) • Create a Solar system model using black poster board as a background and place the planets in order. • Read *Discovering Stars, by* Laurence Santrey Create a "Star Pictures" or a constellation by making a classroom planetarium. Use a pattern of a constellation such as the big dipper and punch holes with a straight pin or sharp pencil on a black sheet of paper. To view the constellation, place the completed sheet on the overhead projector, making sure the black paper covers the glass of the projector. Turn off the lights and allow them to lie on their backs to look up into the night sky. (Technology) • Go outside at three different times throughout the day to track the sun's progress in the sky. Stand at a spot where you can see the sun near a tall tree or flagpole. Show the position of the sun on your paper. Two hours later stand in the same spot, show the position now. Repeat. (Outdoor Education) • Pretend to be an astronaut and record the daily events on the mission to particular planet or the moon. (WP Reflective)

Course/Grade 1st **Unit: Life Science:** *Habitats* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How does life science affect your everyday life? 2. How would you gather and report information about life science?	• Organisms have basic needs (e.g., air water, nutrients, light) and can only survive when these needs are met. *Organisms have basic needs. For example, animals need air, water, and food; plants need air, water, nutrients, and light. Organisms can survive only in environments in which their needs can be met.* • Behavior of individual organisms is influenced by stimuli. • Organisms have different structures that serve different functions. These structures are used to sort organisms into groups. *Things in the environment are classified as living, non-living, and once living. Living things differ from non-living things.* • Organisms are classified into groups by using various characteristics. *Each plant or animals has structures that serve different functions in growth, survival, and reproduction. For example, humans have distinct body structures for walking, holding, seeing, and talking.* • Organisms' patterns of behaviors are related to the nature of organisms' environments. There are many different environments on Earth that support different types of organisms. *The world has many different environments. Distinct environments support the lives of different types of organisms. When the environment changes, some plants and animals survive and reproduce, and others die or move to new locations.*	• Living things live in environments to which they are particularly suited. • Specific habitats and what lives there, for example: Forest (oak trees, squirrels, raccoons, snails, mice), Meadow and prairie (wildflowers, grasses, prairie dogs), Underground (fungi, moles, worms), Desert (cactus, lizard, scorpion) and water (fish, oysters, starfish). • The food chain: a way of picturing the relationships between living things. • Most of the earth is covered with water. • Locate oceans: Pacific, Atlantic, Indian, and Arctic. • Oceans are salt water (unlike fresh water rivers and lakes). • Diversity of ocean floor: from organisms too small for the eye (plankton), to giant whales.	*Students will:* • Begin with answering, where do you live? And where do animals live? • Read or show the video *Is This a House for a Hermit Crab?* written by Eric Carle. • Define the term habitat. • Begin by reading *Deserts*, written by Gail Gibbons. • Locate desert areas on a map or globe. • Discuss the plants and animals that live in deserts. • Brainstorm a list of what lives in the forest? And where forest animals live. • Read *The Gift of the Tree*, by Tresselt. • Using a K-W-L chart, students will list what they already know about meadows and what lives there. • Display pictures of meadows and animals that live there. Discuss what they have in common and what makes they different. • Define the term pond. Display pictures of animals that live in the ponds and ask the students to name them. • Set up an ant farm. Observe their behavior. Record findings. • Bring in some worms. Observe their behavior over several days. Record findings. • Read *Who Eats What?* Define the term food chain. Reread the book focusing on the different food chains from the different habitats. Explain that all living things need food of some kind to give them energy and to keep them alive. • Using state, country and world maps show how water is represented. Using globes show that most of the earth is covered with water. • Using wall maps locate various oceans (Pacific, Atlantic Indian and Arctic). • Make saltwater paintings. Mix salt, water and food coloring to make a paint mixture. Paint picture lightly on paper. Allow to dry. *(Continued next page)*

	All organisms, including humans cause changes in the environment where they live. Some of these changes are detrimental to the organism or to other organisms; other beneficial (e.g., dams built by beavers benefit some aquatic but are detrimental to others). • All animals depend on plants for food. *Plants make their own food. All animals depend on plants. Some animals eat plants for food. Other animals eat animals that eat the plants.* • Organisms resemble their parents. *Plants and animals closely resemble their parents at some time in their life cycle. Some characteristics (e.g., the color of flowers, the number of appendages) are passed to offspring. Other characteristics are learned from interactions with the environment such as the ability to ride a bike a bicycle, and these cannot be passed on to the next generation.*	• Environments are constantly changing, and this can sometimes pose dangers to specific habitats, for example: Effects of population and development, Rainforest clearing, pollution, litter • Dangers to ocean life (for example, over fishing, pollution, oil spills)	• Make an ocean in a bottle. Fill a 2-liter 1/3 full with vegetable oil. Fill remaining with water colored with blue food coloring. Place lid on tightly. Roll on side 2-3 times. Lay lengthways and waves should appear. If available, go on a field trip to an aquarium. • Set-up a classroom aquarium. • Discuss how heavy certain ocean animals are. Compare them with other ocean animals. • Create Ocean Chants. (WP Literary) • Example: • What do you see down in the sea? • I see a _____ in the sea. • What else do you see in the sea? • I see a _____ and he's looking at me! • Take a nature hike observing the habitat and possible changes that may be occurring due to human interference. • (Outdoor Education) • Use various software (Magic School Bus Under On the Ocean Floor, Odell Down Under) to learn more about oceans and the animals that live there. (Technology)

Course/Grade 1st **Unit: Physical Science:** *Matter* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How does physical science affect your everyday life? 2. How would you gather and report information about physical science?	• Materials can exist in different states and some common materials (e.g., water) can change states. *Materials can exist in different states-solid, liquid, and gas. Some common materials, such as water can be changed from one state to another by heating or cooling.* • Properties (e.g., size, shape) of materials can be measured and used to describe, separate, or sort objects. *Objects are made of one or more materials such as paper, wood, and metal. Objects can be described by the properties of the materials from which they are made. Those properties can be used to separate or classify objects or materials.* *Objects have many observable properties such as size, mass, shape, color, temperature, magnetism, and the ability to react with other substances. Some properties can be measured using tools such as metric rulers, balances, and thermometers.*	• Introduce children to the idea that everything is made of matter, and that all matter is made up of parts too small to see. • Names and common examples of three states of matter: • Solid (for example, wood , rocks) • Liquid (for example, water) • Gas (for example, air, steam) • Water as an example of changing states of matter of a single substance	*Students will:* • Define and list the common examples of three states of matter (solids, liquids and gases). • Brainstorm examples of each state of matter on chart paper. • Conduct various experiments to show the changing of the properties of matter. Example: Each student has a paper cup and a plastic spoon. Fill the cup almost to the top with laundry detergent. Add a small amount of water. Add 30 drops of food coloring. Stir well. Place the cup in a warm place for 3-4 days until the water evaporates. Remove the cup and you have a crayon! • Using an adult conduct an experiment to show how water changes states of matter. Measure one cup of water and pour it into a kettle (remove the lid). Bring the water to a boil. After five minutes, turn off. Allow cooling. Remeasure. Discuss finding. Repeat. This time, as water is boiling, place lid a few inches from the kettle spout. Allow students to observe the moisture on the lid. Pour new water in a freezer safe container and place in the freezer. Predict what will happen. Record findings.

Course/Grade 1st **Unit: Physical Science:** *Light and Heat* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How does physical science affect your everyday life? 2. How would you gather and report information about physical science.	• Heat can be produced in many ways such as burning or rubbing. One way heat can move from one object to another is by conduction. Some materials absorb and conduct heat better than other. For example, metal objects conduct heat better than wooden objects. • Light travels in a straight line until it hits an object. Light can be reflected by a shiny object (e.g., mirror, spoon), refracted by a lens (e.g., magnifying glass, eyeglasses), or absorbed by an object (e.g., dark surface).	• Light produces heat (natural and man-made) • Light travels in straight lines • Reflection • Speed of light	*Students will:* • Use mirrors to demonstrate that light travels in a straight line (light will bounce off a mirror at the same angle that it hits the mirror). • Use mirrors to reflect images. • Use dark construction paper to absorb heat from sunlight and man-made sources of light. (Outdoor Education) • Research using encyclopedias, CD-Roms, Software, Internet, or books about light. (Technology) • Using a hand held mirror create a self-portrait using language and/or art. (WP Personal Narrative)

Course/Grade 2nd **Unit: Earth and Space Science:** *Introduction to the Solar System* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How does Earth and Space Science affect your everyday life? 2. How would you gather and report information about Earth and Space Science?	• The Sun provides the light and heat necessary to maintain the temperature of the Earth. *The Sun provides the light and heat necessary to maintain the temperature of Earth. The Sun's light and heat are necessary to sustain life on Earth.* • Common objects in the sky (e.g., stars, clouds, airplanes) have properties, locations, and movements that can be observed and described. *Objects in the sky (e.g., Sun, clouds, moon) have properties, locations, and real or apparent movements that can be observed and described.* • Objects in the sky (e.g., Sun, moon) have patterns of movement. *Changes in movement of objects in the sky have patterns that can be observed and described. The Sun appears to move across the sky in the same way every day, but the Sun's apparent path changes slower over the seasons. The moon moves across the sky on a daily basis much like the Sun. The observable shape of the moon changes from day to day in a cycle that lasts about a month.*	• Constellations, Big Dipper • Earth and its place in the solar system • Moon: phases of the moon (full, half, crescent, new) • Stars • Sun: source of energy, light, heat • Sunrise and sunset • The earth moves around the sun; the sun does not move. • The earth revolves (spins); one revolution takes one day (24 hours). • The nine planets (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto) • The sun is a star. • When it is day where you are, it is night for people on the opposite side of the earth.	*Students will:* • Use a globe to see how the Earth spins on its axis and to see that the axis is tilted. Use an electric heater to represent the sun. Slowly spin the globe and circle the heater. Decide where the sun is in relation to the seasons in the United States. • Read The Cloud Book by Tomie DePaola. Use shaving cream or whipped cream, on desks, to make models of cumulus, stratus, and cirrus clouds. • Using a flashlight, globe, and paper tent, demonstrate how the light lights the earth and show what happens as the earth rotates. Show how the paper tent casts a shadow on the globe as it rotates. • Conduct sun/heat experiments. Predict and record what happens when ice is left in the sun. List thing that should be left in the sun or in the shade. • Create a moonscape, using clay, sand, rocks and gray paint. • Compare the earth's surface with the moon's surface. • Create a Moon Chart. Show the moons in this order (full, half, crescent, new) (Outdoor Education) • Using various means, they will each research one of the nine planets. They will report to the class and they will be videotaped, in order to review at end of the unit. (Technology) • Create a Solar system model using black poster board as a background and place the planets in order. *(Continued next page*

			• Read *Discovering Stars, by* Laurence Santrey. Create a "Star Pictures" or a constellation by making a classroom planetarium. Use a pattern of a constellation such as the big dipper and punch holes with a straight pin or sharp pencil on a black sheet of paper. To view the constellation, place the completed sheet on the overhead projector, making sure the black paper covers the glass of the projector. Turn off the lights and allow them to lie on their backs to look up into the night sky. • Go outside at three different times throughout the day to track the sun's progress in the sky. Stand at a spot where you can see the sun near a tall tree or flagpole. Show the position of the sun on your paper. Two hours later stand in the same spot, show the position now. Repeat. • Students will pretend they are astronauts and record daily events that occur on their missions to other planets.

Course/Grade 2nd **Unit: Life Science:** *Animals* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How does Life Science affect your everyday life? 2. How would you gather and report information about Life Science?	• Organisms have basic needs and can only survive when these needs are met. *Organisms have basic needs. For example, animals need air, water, and food; plants need air, water, nutrients, and light. Organisms can survive only in environments in which their needs can be met.* • Behavior of individual organisms is influenced by stimuli • Organisms have different structures that serve different functions. These structures are used to sort organisms into groups. *Each plant or animal has different structures that serve different functions in growth, survival, and reproduction. For example, humans have distinct body structures for walking, holding, seeing, and talking.* *Things in the environment are classified as living, nonliving, and once living. Living things differ from nonliving things. Organisms are classified into groups by using various characteristics (e.g., body coverings, body structures).* • Organisms resemble their parents. *Plants and animals closely resemble their parents at some time in their life cycle. Some characteristics (e.g., the color of flowers, the number of appendages) are passed to offspring. Other characteristics are learned from interactions with the environment such as the ability to ride a bicycle, and these cannot be passed on to the next generation.*	• The life cycle: birth, growth, reproduction, death • Reproduction in animals: from egg to egg with a chicken, from frog to frog, from butterfly to butterfly (metamorphosis) • Insects can be helpful and harmful to people • Helpful: pollination; products like honey, beeswax, and silk; eat harmful insects • Harmful: destroy crops, trees, wooden buildings, clothes; carry disease; bite or sting • Distinguishing characteristics of insects (exoskeleton, chitin, six legs and three body parts: head, thorax, abdomen; most but not all insects have wings)	*Students will:* • Observe the life cycle of frogs, mealworms, or butterflies. • Visit The Butterfly Show at Krohn Conservatory in May. (Outdoor Education) • See Creepy Crawlies from Teacher Created Materials as references. • Read books about insects or use the Internet to conduct research. Make a chart of Name of Insect, How it can be Helpful, and How it can be Harmful. • Identify the head, thorax, and abdomen on pictures of insects. • Draw and/or label a diagram of an insect. • Divide small paper plate into 4 sections. Glue pasta, or beans, on each section and label: – Egg - small bean – Larvae - elbow macaroni – Pupa - shell macaroni – Adult - Bowtie macaroni • Observe life cycle of mealworms for stages of egg, larva, pupa, and adult. • Pretend you are in the pupa stage and tell what it is like to go through metamorphosis. (WP Reflective) • Use magnification to study the parts of an insect. (Technology) *(Continued next page)*

	• Organisms have life cycles that are different for different organisms. *Plants and animals have life cycles that include the beginning of life, growth and development, reproduction, and death. The details of a life cycle are different for different organisms.* • Organisms' patterns of behavior are related to the nature of organisms' environments. There are many different environments on Earth that support different types of organisms. *The world has many different environments. Distinct environments support the life of different types of organisms. When the environment changes, some plants and animals survive and reproduce, and others die or move to new locations.* • All animals depend on plants for food. *Plants make their own food. All animals depend on plants. Some animals eat plants for food. Other animals eat animals that eat the plants.*	• Metamorphosis (some insects look like miniature adults when born from eggs, and they molt to grow. Example: grasshopper, cricket. Some insects go through distinct stages of egg, larva, pupa, adult. For example: butterflies, ants.)	

Course/Grade 2nd **Unit: Physical Science:** *Magnetism* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How does physical science affect your everyday life? 2. How would you gather and report information about physical science?	• Properties (e.g., size, shape) of materials can be measured and used to describe, separate, or sort objects. *Objects have many observable properties such as size, mass, shape, color, temperature, magnetism, and the ability to react with other substances. Some properties can be measured using tools such as metric rulers, balances and thermometers.* • The position and motion of an object can be changed by pushing or pulling. *The position and motion of objects can be changed by pushing or pulling. The amount of the change in position and motion is related to the strength of the push or pull force. The force with which a ball is hit illustrated this principle.* • Magnets attract and repel each other as well as certain kinds of other materials. *Magnets attract and repel each other, and magnets attract certain kinds of other materials (e.g., iron).*	• Magnetism demonstrates that there are forces we cannot see that act upon objects. • Most magnets contain iron. • Magnetic poles are north-seeking and south-seeking poles • Magnetic fields are strongest at the poles. • The law of magnetic attraction is that unlike poles attract and like poles repel. The earth behaves as if it were a huge magnet: north and south magnetic poles. (They are near but not the same as, geographic North Pole and South Pole.)	*Students will:* • Test objects with a magnet to determine which of the objects can be attracted by the magnet. • Discuss the properties of objects that are attracted to magnets. • Use a compass and show how the compass needle is attracted to the north part of the compass just as metal objects are attracted to magnets. • Brainstorm how magnets are used in real life.

Course/Grade **2nd** **Unit: Physical Science:** *Electricity* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How does physical science affect your everyday life? 2. How would you gather and report information about physical science?	• Electrical currents move through electrical circuits. Electricity in circuits can produce light. *Electricity in circuits can produce light, heat, sound, and magnetic effects. Electrical circuits require a complete conducting path through which an electrical current can pass.*	• Through reading aloud, observation and experiment explore with children basic principles of electricity and electrical safety rules. • Static electricity • Basic parts of simple electric circuits (for example, batteries, wire, bulb or buzzer, switch) • Conductive and nonconductive materials • Safety rules for electricity (for example, never put your finger or anything metallic, in an electrical outlet; never touch a switch or electrical appliance when your hands are wet or when you 're in the bathtub; never put your finger in a lamp socket; etc.)	*Students will:* • Brainstorm and list things that use electricity. • Disassemble a flashlight and discuss the function of each part. • Demonstrate and construct a simple circuit, using a battery, wire and small bulb. • Draw and write about safe use of electricity. • Blow up a balloon and rub it on the carpet and then allow it to touch a wall. It will stick because of the static electricity. • Read aloud or research books or the Internet about Thomas Edison. (Technology) • If available, view video about the life of Thomas Edison (Thomas Edison and the Electric Light). • Make pictures of Thomas Edison's inventions and in small groups create mobiles. • Write how life would be different for you if you lived before Thomas Edison (without electricity). (WP Reflective) • Discuss safety issues regarding placement of power lines. (Outdoor Education)

Course/Grade 3rd **Unit: Earth and Space Science:** *Weather* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. Why is it important to collect and communicate weather information?	• The Sun provides the light and heat necessary to maintain the temperature of the Earth. *The Sun provides the light and heat necessary to maintain the temperature of Earth. The Sun's light and heat are necessary to sustain life on Earth.* • Common objects in the sky (e.g., stars, clouds, airplanes) have properties, locations, and movements that can be observed and described. *Objects in the sky (e.g., Sun, clouds, moon) have properties, locations, and real or apparent movements that can be observed and described.* • Weather changes from day to day and over the seasons. *The surface of the Earth changes. Some changes are due to slow processes such as erosion or weathering. Some changes are due to rapid processes such as landslides, volcanic eruptions, and earthquakes*. • Weather changes from day to day and over seasons. *Weather can be described by observations and measurable quantities such as temperature, wind direction and speed, and precipitation.* • Objects in the sky (e.g., Sun, moon) have patterns of movement. *Changes in movement of objects in the sky have patterns that can be observed and described. The Sun appears to move across the sky in the same way every day, but the Sun's apparent path changes slowly over seasons. The moon moves across the sky on a daily basis much like the Sun. The observable shape of the moon changes from day to day in a cycle that lasts about a month.*	• Clouds • Cold and warm fronts • Precipitation; rain, snow, sleet, hail • Sun is the main source of heat, light, and energy. • Temperature, thermometers • Thunderstorms and lightning • Water cycle includes: evaporation, condensation, water vapor in the air (humidity), clouds (cirrus, cumulus, stratus), and precipitation (groundwater). • Weather patterns • Weathering and erosion • Wind direction and speed	*Students will:* • Illustrate, label, and explain the water cycle (power point presentation) • Make rain. Pour warm water into one glass jar about 1/3 full and cold water into another jar. Place a plastic bag of ice cubes into pie pans and put on top of the jars. • Use books and or inter-net to find photos of clouds. Write the descriptions of the clouds and what the weather conditions are when the clouds are formed (e.g., cirrus, nimbus, cumulus, stratus) • Investigate different tools to measure wind speed and direction (wind sock, weather vane, Beaufort scale and anemometer) • Observe local weather conditions and record weather data (e.g., time and temperature, wind direction and speed, clear or cloudy, precipitation) for one month. Use pictographs, bar graphs, and line plots to display weather data. • Use inter-net radio, television, and newspaper weather reports to collect information on weather conditions in other cities, regions, countries, or continents. Discuss how people in each location may adjust to weather conditions.

Course/Grade 3rd **Unit:** **Earth and Space Science:** *Pollution and Conservation* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How does pollution have a negative effect on the community? 2. Why is conservation of energy and resources an effective means of protecting the environment?		• Earth Day • Littering, smog, water pollution • Natural resources • Recyclable items (e.g., paper, aluminum, glass) • Ways to conserve energy and resources.	*Students will:* • Plant a tree in the school yard. • Recycle items in the classroom for an extended period of time. Weigh, sort, measure, explore the items in your recycle bin. Calculate how much you could recycle in two weeks time, one month, two months etc. • Identify a real world problem (e.g., the effects of acid rain or littering on fertile soil). Set up an experiment to test your hypothesis. • Have the class list efforts to conserve energy or resources.

Course/Grade 3rd **Unit: Life Science:** *Organisms and Plants* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
• How do plants impact my life on a daily basis.	• Organisms have different structures that serve different functions. These structures are used to sort organisms into groups. *Things in the environment are classified as living, nonliving, and once living. Living things differ from nonliving things. Organisms are classified into groups by using various characteristics (e.g., body coverings, body structures).* *Each plant or animal has structures that serve different functions in growth, survival, and reproduction. For example, humans have distinct body structures for walking, holding, seeing, and talking.* • Organisms have basic needs (e.g., air, water, nutrients, light) and can only survive when these needs are met. *Organisms have basic needs. For example, animals need air, water, and food; plants need air, water, nutrients, and light. Organisms can survive only in environments in which their needs can be met.* • Behavior of individual organisms is influenced by stimuli (e.g., touch, hunger). • Organisms have life cycles that are different for different organisms. *Plants and animals have life cycles that include the beginning of life, growth and development, reproduction, and death. The details of a life cycle are different for different organisms.* • Organisms resemble their parents. *Plants and animals closely resemble their parents at some time in their life cycle. Some characteristics (e.g., the color of flowers, the number of appendages) are passed to offspring. Other characteristics are learned from interactions with the environment such as the ability to ride a*	• Characteristics • Classification • Different environments support varied plant life. • Environment • Life Cycles • Plants are essential for life. • Plants evolve from seed to seed. • Plants have basic needs (air, water, light, nutrients) • Plants have different structures and functions; these structures are used to sort plants into groups. • Plants have life cycles that are different than other organisms.	*Students will:* • Draw a diagram of the three parts of a seed (seed coat, food storage, embryo) after soaking a bean overnight and carefully prying it open. Plant similar fast growing beans in soil to observe the growth of the plant. • Cut open and observe the seeds inside fruits and vegetables. Plant the seeds. • Identify a real-world problem (e.g., effects of soil acidity on seed germination, methods for erosion control) and design an experiment to test a possible solution. • Conduct experiments with plants using soil, water, and sunlight amounts as variables. Record changes on a spreadsheet. Display results. • Observe, chart, and explain changes that occur in a terrarium over a month comparing factors such as sunlight, water, temperature, plant life. • Determine the influence of light and gravity on seed germination and growth. Use the information to select the best place in the school to grow plants. *(Continued next page)*

	bicycle, and these cannot be passed on to the next generation. • All animals depend on plants for food. *Plants make their own food. All animals depend on plants. Some animals eat plants for food. Other animals eat animals that eat the plants.* • Organisms' patterns of behavior are related to the nature of organisms' environments. There are many different environments (e.g., deserts, rainforests) on Earth that support different types of organisms. *The world has many different environments. Distinct environments support the lives of different types of organisms. When the environment changes, some plants and animals survive and reproduce, and others die or move to new locations.* *All organisms, including humans, cause changes in the environment where they live. Some of these changes are detrimental to the organism or to other organisms; other changes are beneficial (e.g., dams built by beavers benefit some aquatic organisms but are detrimental to others).*		

Course/Grade 3rd **Unit: Physical Science:** *Electricity* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How has the invention of electricity improved your lifestyle?	**INSERT POS HERE** *Objects have many observable properties such as size, mass, shape, color, temperature, magnetism, and the ability to react with other substances. Some properties can be measured using tools such as metric rulers, balances, and thermometers.* *Objects are made of one or more materials such as paper, wood, and metal. Objects can be described by the properties of the materials from which they are made. Those properties can be used to separate or classify objects or materials.* *Light travels in a straight line until it strikes an object. Light can be reflected by a shiny object (e.g., mirror, spoon), refracted by a lens (e.g., magnifying glass, eyeglasses), or absorbed by an object (e.g., dark surface).* • Electrical currents move through electrical circuits. Electricity in circuits can produce light. *Electricity in circuits can produce light, heat, sound, and magnetic effects. Electrical circuits require a complete conducting path through which an electrical current can pass.*	• Basic parts of simple electrical circuits (batteries, wire, bulb, buzzer, switch) • Conductive and non-conductive materials • Electrical currents move through electrical circuits. • Electricity in circuits can produce light, heat, sound, and magnetic effects. • Safety rules • Static electricity	*Students will:* • Use batteries, bulbs, and wires to make bulbs light; investigate ways to make the light brighter. • Illustrate a closed circuit. Describe the path of the electricity from the time it leaves the battery until it returns to the battery. • Determine what is wrong with circuits (e.g., flashlight with missing parts). Describe in electricity journal. • Investigate good and poor conductors of electricity. • Do research on Michael Farraday or Thoma Edison. • Write a portfolio piece on how life would be different without electricity. • Identify the self-regulating components of an electrical system in you home or community that work to achieve a balance (e.g., thermostat on a heating system, traffic lights to control traffic patterns, time periods in a sporting event). • Observe the behavior of charged materials and infer the cause of the behavior. Blow up two balloons. Tie a string to each. Rub each balloon with a piece of nylon (or wool). Bring the balloons near each other. Observe what happens. Blow up two more balloons. Repeat using plastic wrap instead of the nylon. Bring one balloon rubbed with nylon close to one balloon rubbed with plastic wrap, observe.

Course/Grade 3rd **Unit: Physical Science:** *Simple Machines* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How does my body push and pull on a daily basis to change the common object or use in play?	• The position and motion of an object can be described (e.g., measured, observed) by comparing it to another object or background. *The position of an object can be described by locating it relative to another object or the background. The position can be described using phrases such as to the right, to the left, 50 cm from the other object.* *An object's motion can be described by measuring its change in position over time such as rolling different objects (e.g., spheres, toy cars) down a ramp.* • The position and motion of an object can be changed by pushing or pulling. *The position and motion of objects can be changed by pushing or pulling. The amount of change in position and motion is related to the strength of the push or pull (force). The force with which a ball is hit illustrates this principle.* *Vibration is a type of motion. Sound is produced by vibrating objects. The pitch of the sound can be varied by changing the rate of vibration.* *Heat can be produced in many ways such as burning or rubbing. One way heat can move from one object to another is by conduction. Some materials absorb and conduct heat better than others. For example, metal objects conduct heat better than wooden objects.*	• An objects position and motion can be changed by pushing or pulling. • Friction Lubricants, rollers, etc. are used to reduce Friction. • Simple machines include: lever, pulley, wheel-and axle, gears, inclined plane, wedge, and screw.	*Students will:* • Identify examples of simple machines in the community. • Try to lift a heavy block or rock with or without a board as a lever (use triangle block as a fulcrum). Put the fulcrum at various locations to see when it is the easiest to lift. • Construct two pulleys out of two spools, two coat hangers, and a long piece of string. Connect one to a door handle and one to another door or handle of a cupboard, with the string connecting the two pulleys in a pulley system. • Set up an inclined plane on carpet. Roll balls down the plane and record where they stop. Change the slope of the incline. Explain that the balls come to a rest due to gravity and friction. • Put together two 2x4x12 pieces of wood with a nail and two more 2x4x12 pieces of wood with a screw. Try to get the boards apart with a pry bar. Notice the mechanical advantage of a crew over a nail. • Portfolio biography piece on Elijah McCoy.

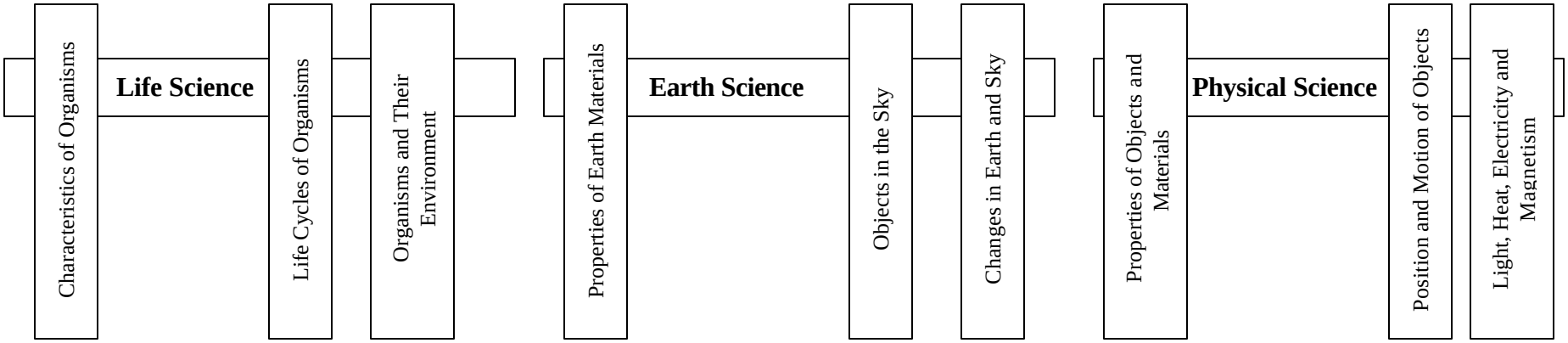
Intermediate Science Curriculum
Fourth Grade

Description:
Fourth grade science instruction will focus on Life, Physical, and Earth and Space Sciences. This will build on the background provided in grades K-2. The third and fourth grade curricula have been designed to complement each other in preparation for the fourth grade spring assessment. Here, students will gain knowledge in Communication, Technology, Outdoor Education, and Higher Level Thinking.

Students will engage in active construction of ideas and explanations that will enhance their opportunities to develop the abilities of "doing science". Students will focus on the processes of completing investigations, develop the ability to ask scientific questions, investigate aspects of the world around them, and use their observations to construct reasonable explanations for the questions posed. These learning experiences will enhance the students' natural curiosity of science and empower them to explore science in their everyday lives.

All science instruction should use an inquiry approach since it is researched based and reflected in our state assessment.

Fourth Grade Units:



Course Questions:

To achieve our goals, the following questions were designed to be considered during fourth grade.

A. How does science affect your everyday life?
B. How would you gather and report information about science?

The following standards are taught in all units:

- Ask simple scientific questions that can be answered through observations combined with scientific information.
  Ask simple scientific questions that can be investigated through observations combined with scientific information.
- Use simple equipment (e.g., aquariums), tools (e.g., magnifiers, spoons), skills (e.g., observing, pouring), technology (e.g., video discs), and mathematics in scientific investigations.
  Use simple equipment (e.g., magnifiers, magnets), tools (e.g., metric rulers, thermometers), skills (e.g., classifying, predicting), technology (e.g., electronic media, calculators, World Wide Web), and mathematics in scientific investigations.
- Use evidence (e.g., observations) from simple scientific investigations and scientific knowledge to develop reasonable explanations.
  Use evidence (e.g., observations, data) from simple scientific investigations and scientific knowledge to develop reasonable explanations.
- Design and conduct different kinds of simple scientific investigations.
  Design and conduct simple scientific investigations.
- Communicate (e.g., draw, graph, write) designs, procedures and results of scientific investigations.
  Communicate (e.g., draw, graph, write) designs, procedures, observations, and results of scientific investigations.
- Review and ask questions about scientific investigations and explanations of other students.
  Review and ask questions about scientific investigations and explanations of other students.
- Use science to design simple technological solutions (e.g., paper clips, stapler) to problems.
  Distinguish between natural objects and objects made by humans and examine the interaction between science and technology. Technology (e.g., thermometer, hand lens) is used to study science, while science provides theories for technology. Science is used to design simple technological solutions to problems (e.g., use understanding of heat and transfer in designing an insulated container for ice cubes).
- Describe the role of science and technology in dealing with local issues (e.g., landfill location).
  Examine how designing and conducting scientific investigations fosters and understanding of issues related natural resources (e.g., scarcity), demonstrate how the study of science (e.g., aquariums, living systems) helps explain changes in environments, and examine the role of science and technology in communities (e.g., location of landfills, new housing developments).
- Examine the role science plays in everyday life.
  Examine the role science plays in everyday life.

Course/Grade 4th **Unit: Earth and Space Science:** *Properties of Earth's Materials* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. What materials make up our Earth?	• Earth's materials are solids (e.g., rocks, soils), water (e.g., oceans), and gases (e.g., oxygen). *Earth's materials are solid rocks, soils, water, and the gases of the atmosphere. Minerals that make up the rocks have properties of color, texture, the capacity of retaining water, and the ability to support plant growth. Water on the earth and in the atmosphere can be a solid, liquid, or gas.* • Earth's materials have different physical and chemical properties and provide resources that humans use. *Earth materials provide many of the resources that humans use. The varied materials have different physical and chemical properties, which make them useful in different ways, for example, as building materials (e.g., stone, clay, marble), as sources of fuel (e.g., petroleum, natural gas), or growing the plants we use as food.* • Fossils provide evidence about organisms that lived long ago. *Fossils found in Earth materials provide evidence about organisms that lived long ago and the nature of the environment at that time.*	• Earth's layers • Rocks and minerals – Formation of metamorphic, igneous, and sedimentary rock – Characteristics of metamorphic, igneous, and sedimentary rock • Soil and its components • How mountains are formed • Volcanoes • Pangaea and continental drift • Resources humans use from the Earth • Fossils and fossil fuels	*Student will:* • Have students act as a geologist to take "core samples" from a model of the earth's crust. Using a layer cake as a model of the earth's crust, students insert straws and remove a "core sample" by squeezing it from the empty end towards the sample. Record observations in science journal. • Use a model of the earth's layers. Students construct a sugar cube building on their model. Students tap the surface of the model, simulating an earthquake. Students should form a hypothesis, gather data, and draw conclusions about the strength of the quake at the epicenter, on the earth's surface, and a distance away from the epicenter. • Construct a model of an active volcano. Mixing baking soda and vinegar will allow the volcano to be "active". • Spread a sample of different rocks on a table. Have students examine the rock samples. Think of properties that could be used to sort, or classify, the rocks. Based on those properties sort the rocks and group them. Make a drawing that shows your results. • Make a model of a sedimentary rock by placing water, soil, sand, and gravel into a container that has a lid. Put the lid on tightly and shake the container. Observe the container for 15 minutes. Leave the container in place overnight and observe it the next day. In science journal, make a drawing of what you see. • Write a paragraph from the point of view of Earth components (e.g., coal, oil, rock, sand, soil) describing how they were made and identify how used. (WP—literary/transactive) • View *Magic School Bus-Inside the Earth* • Investigate where coal deposits are found. Map areas where fossil fuels are found in Kentucky. Explain how coal forms, why coal is only found in certain areas, and how coal and mining impacts economics and the environment. Create models to show how coal forms. Write a description/report to complement models. (WP—transactive)

Course/Grade 4th **Unit: Earth and Space Science:** *Objects in the Sky* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. What can we learn about the sun and other objects in the sky?	• The sun provides the light and heat necessary to maintain the temperature of the Earth. *The sun provides the light and heat necessary to maintain the temperature of the Earth. The sun's light and heat are necessary to sustain life on Earth.* • Common objects in the sky (e.g., stars, clouds, airplanes) have properties, locations, and movements that can be observed and described. *Common objects in the sky (e.g., sun, clouds, moon) have properties, locations, and real or apparent movements that can be observed and described.* • Object in the sky (e.g., sun, moon) have patterns of movement. *The surface of the Earth changes. Some changes are due to slow processes such as erosion or weathering. Some changes are due to rapid processes such as landslides, volcanic eruptions, and earthquakes.*	• Sun – Light, heat and life on Earth – Movement • Other objects—properties, location, and movement – Stars – Moon – Clouds—cirrus, stratus, cumulus	*Students will:* • Use thermometers to collect data demonstrating how outside temperature is influenced by sunlight and how temperature changes over time. Explore differences in temperatures measured in sun and shade. Perform long term investigations by recording temperature in the shade and observing weather conditions every hour throughout the school day. Repeat process for several days with a variety of weather conditions (e.g., sunny, cloudy) producing daily line graphs summarizing temperatures vs. time of day. Interpret graphs to infer effect sun and weather conditions have on temperature of our daily environment and to predict temperature patterns for future days. Extend this activity by hypothesizing what the temperature pattern may be during the night and follow up with measurements at home. Produce temperature vs. time graphs throughout the year. Compare data from different seasons. Design projects to demonstrate how clothing worn by peers in other parts of the world is affected by temperature in their environment. • Observe and describe the moon. Draw the moon's shape on a calendar each day for a month. Note whether the moon is visible in daytime or nighttime. • Describe how and why student shadows change in the course of a day. • Establish a class weather station, write articles and report to the other classes in the school. (WP—transactive)

Course/Grade **4th** **Unit: Earth and Space Science:** *Changes in Earth and Sky* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
A. What evidence can I gather to show patterns and change over time in the Earth and sky?	• Weather changes from day to day over the seasons. Weather can be described by observing and measuring temperature, wind direction, speed, and precipitation. *Weather can change from day to day and over seasons. Weather can be described by observations and measurable quantities, such as temperature, wind direction and speed, and precipitation* • Earth's surface changes are due to slow (e.g., weathering) and rapid (e.g., volcanic eruptions) processes. *Changes in the movement of objects in the sky have patterns that can be observed and described. The sun appears to move across the sky in the same way every day, but the sun's apparent path changes slower over the seasons. The moon moves across the sky on a daily basis much like the sun. The observable shape of the moon changes from day to day in a cycle that lasts about a month.*	• Weathering and Erosion – Physical and chemical weathering – Weathering and erosion by water, wind, and glaciers – The formation of soil: topsoil, subsoil, bedrock • Weather review (from 3rd grade) – temperature – wind speed/direction – precipitation • Sun/Moon paths/movements	*Student's will:* • Fill a cup about one-quarter full with vinegar. Add a piece of chalk to the cup of vinegar. Record you observations and a sketch. Predict what will happen if the chalk was left in the vinegar for several days. • Test effects of various liquids (e.g., lemon juice, vinegar, seltzer water) on different materials (e.g., metal, wood, glass). Record and compare observations. Describe how acid rain affects the Earth. (WP—transactive) • Write a tale of rocks in the area and how they change. Include weathering and the rock cycle. (WP—literary) • Use the Internet or other means to communicate with local meteorologists to discuss the use of weather maps and study of meteorology. Create class weather stations. Determine what instruments (e.g., weather vanes, windsocks) should be developed, organize materials, assign tasks. • Explore the characteristics of air. Investigate what makes the wind blow. Develop poetry or dramatic interpretations to describe how wind affects objects in their community. (WP—literary) • Record the position of Sun and the movement of shadows during the course of the day. Measure length of shadows, record on graphs, and communicate patters of movement. Explain procedures and results. Review and ask questions about investigations.

Course/Grade **4th** **Unit: Life Science:** *Characteristics of Organisms* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How are characteristics of organisms different and similar?	• Things in the environment are classified as living, nonliving, and once living. Living things differ from nonliving things. Organisms are classified into groups by using various characteristics (body coverings, structures, etc.) *Organisms have basic needs (e.g., water, air, nutrients, light) and can only survive when these needs are met.* *Organisms have basic needs. For example, animals need air, water, and food; plants need air, water, nutrients and light. Organisms can survive only in environments where their needs can be met.* • Behavior of individual organisms is influenced by stimuli. (e.g., touch, hunger). *Organisms have different structures that serve different functions. These structures are used to sort organisms into groups.* *Each plant or animal has different structures that serve different functions in growth, survival, and reproduction. For example, humans have distinct body structures for walking, holding, seeing, and talking.*	• Classification • Basic needs • Behavior/Reaction to stimuli • Anatomy • Physiology	*Students will:* • Investigate basic needs of organisms. Observe locations (e.g., sun, shade, water, moist, dry) of types of flowers/insects around homes and schools. Use secondary data (e.g. internet, books, magazines) to research various flowers/creatures observed. Publish data about organisms and use to create school/home beautification plans that will include specifics such as where additional flowers can and should be planted. Share work with local florists, nurseries, or garden clubs. WP • Investigate behavior of organisms (e.g. plants, animals, fungi, protists, monera). Design experiments to investigate plants' reactions to various stimuli (e.g. gravity, light). Discuss reasons for observations. Write articles discussing needs of organisms and share with peers. • Investigate protective techniques (e.g., camouflage, mimicry) of organisms. Create children's books on organisms' protective behaviors and characteristics. Read books to primary classes. (WP—transactive) • Classify groups of objects (e.g. buttons) based on physical characteristics. Create dichotomous keys. Observe groups of organisms (e.g., plants, animals, fungi) and group based on physical traits. Create dichotomous keys for organisms. Compare student keys to scientific keys. Identify characteristics scientists use to classify organisms. Explain how structures are related to functions.

Course/Grade **4th** **Unit: Life Science:** *Life Cycles of Organisms* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. What patters exist in organisms' life cycles?	• Organisms have life cycles that are different for different organisms. *Plants and animals have life cycles that include the beginning of life, growth and development, reproduction, and death. The details of a life cycle are different for different organisms.* • Organisms resemble their parents. *Plants and animals closely resemble their parents at some time in their life cycle. Some characteristics (e.g., color of flower, number of appendages) are passed to offspring. Other characteristics are learned from interactions with the environment such as the ability to ride a bicycle, and these cannot be passed on to the next generation.* • Characteristics of organisms are inherited or learned. *Plants and animals closely resemble their parents at some time in their life cycle. Some characteristics (e.g., color of flower, number of appendages) are passed to offspring. Other characteristics are learned from interactions with the environment such as the ability to ride a bicycle, and these cannot be passed on to the next generation.* • All animals depend on plants for food. *Plants make their own food. All animals depend on plants. Some animals eat plants for food. Other animals eat animals that eat the plants.*	• Inherited/learned characteristics • Parent resemblances • Stages of life cycles	*Students will:* • Design simple, comparative tests to determine organisms (e.g. plants, animals) preferences (e.g. heat, temperature, moisture). Collect, record, and analyze data for a specific variable and share with the class. Use class data to draw conclusions as to types of environments best for certain organisms. Establish terraria or aquaria systems that model different environments based on the conclusions from the previous activity. Observe and maintain throughout the year. Design booklets, brochures, or posters that focus on a plant or animal and type of environment required to care for it. Post by the aquaria or terraria and share. (WP—transactive) • Observe, illustrate, and describe simple food chains and webs, differentiating between predator and producers and consumers by adopting small (1 foot square) areas of land in various locations at school. Create public service announcements indicating importance of various organisms in and around schools. • Use secondary data (e.g. books, internet, magazines) to compare characteristics and habits of organisms which live in different environments (e.g. grassland, desert, rainforest). Consider the effects of introducing or reintroducing organisms into new environments (e.g. elk in eastern Ky., original vegetation to Big Bone Lick State Park). Create brochures to outline possible benefits or risks to local regions. (WP—transactive) Schedule a visit by a naturalist of the Kentucky state parks to discuss how organisms/environment have changed our state over time.

Course/Grade **4th** **Unit: Life Science:** *Organisms and Their Environments* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How do environments and organisms affect each other?	• Organisms' patterns of behavior are related to the organisms' environments. There are many different environments (e.g., deserts, rainforests) on Earth that support different types of organisms. *The world has many different environments. Distinct environments support the life of different organisms. When the environment changes, some plants and animals survive and reproduce, and others die or move to new locations.* • Organisms change the environment. These changes may be detrimental or beneficial. *All organisms, including humans, cause changes in the environment where they live. Some of these changes are detrimental to the organism or to other organisms; other changes are beneficial (e.g., dams build by beavers benefit some aquatic organisms, but are detrimental to others).*	• Patterns of behavior related to environment • Dependency of organisms on each other • Organisms change their environment	*Students will:* • Design simple, comparative tests to determine organisms (e.g. plants, animals) preferences (e.g. heat, temperature, moisture). Collect, record, and analyze data for a specific variable and share with the class. Use class data to draw conclusions as to types of environments best for certain organisms. Establish terraria or aquaria systems that model different environments based on the conclusions from the previous activity. Observe and maintain throughout the year. Design booklets, brochures, or posters that focus on a plant or animal and type of environment required to care for it. Post by the aquaria or terraria and share. (WP—transactive) • Observe, illustrate, and describe simple food chains and webs, differentiating between predator and producers and consumers by adopting small (1 foot square) areas of land in various locations at school. Create public service announcements indicating importance of various organisms in and around schools. • Use secondary data (e.g. books, internet, magazines) to compare characteristics and habits of organisms which live in different environments (e.g. grassland, desert, rainforest). Consider the effects of introducing or reintroducing organisms into new environments (e.g., elk in eastern Ky., original vegetation to Big Bone Lick State Park). Create brochures to outline possible benefits or risks to local regions. (WP—transactive) Schedule a visit by a naturalist of the Kentucky state parks to discuss how organisms/environment have changed our state over time.

Course/Grade 4th **Unit: Physical Science:** *Properties of Objects and Materials* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How can I investigate the properties of matter?	• Properties (e.g., size, shape) of materials can be measured and used to describe, separate, or sort objects. *Objects have many observable properties such as size, mass, shape, color, temperature, magnetism, and the ability to react with other substances. Some properties can be measured using tools such as metric rulers, balances, and thermometers.* *Objects are made of one or more materials such as wood, paper, and metal. Objects can be described by the properties of materials from which they are made. Those properties can be used to separate or classify objects or materials.* • Materials can exist in different states and some common materials (e.g., water) can change states. *Materials can exist in different states—solid, liquid, and gas. Some common materials, such as water, can be changed from one state to another by heating or cooling.*	• States of matter – Solid – Liquid – Gas • Properties of Matter – Mass – Volume – Density – Vacuum	*Students will:* • Make observations about objects to group them according to different properties. Determine if items are grouped the same if you use a different property (e.g., mass versus color). • Write riddles, jokes, magic tricks, and poems that describe states of matter. Compile pieces into science-literary booklets. (*WP—literary)* • Fill identical small containers (e.g., Film canisters, yogurt containers with lids) with a variety of materials (e.g., rice, cotton, coins, sand, stones, water, popped and unpopped corn, bird seed, rubber bands, and oatmeal) of different densities. Use scales or balances and standard units of measure to weigh each container. Measure volume of containers and include with data. Display results in bar graphs. Analyze data and formulate conclusions in groups and report to entire class for discussion. Utilize data as evidence to write about the question, "Do big things weigh more than little things?" and explain how data helped formulate their reasoning. Discuss individual conclusions and examples. Write answers to open response questions exploring differences and similarities among basketballs, bowling balls, beach balls, and explaining why each is used for its particular sport.. • Design comparative tasks and experiments to explore rate of evaporation of water. Students will determine what factors (e.g., Temperature of water, surface area of water, humidity, and temperature of surrounding air) influence evaporation rate. Compile data in groups and make generalizations. Apply conclusions to predict most efficient conditions for drying wet laundry without dryers. Investigate the relationship of weight and nutritional value of natural and prepared foods. Formulate generalizations based on these findings and present them with supporting evidence on consumer guide posters (e.g., Boxes of breakfast foods, bags of potato chips).

Course/Grade **4th** **Unit: Physical Science:** *Position and Motion of Objects* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. What factors influence motion and what effects result from motion?	• The position and motion of an object can be described (E.g., measured, observed) by comparing it to another object or background. *The position of an object can be described by locating in relative to another object or background. The position can be described using phrases such as to the right, to the left, 50 cm from the other object.* *An object's motion can be described by measuring its change in position over time such as rolling different objects (e.g., spheres, toy cars) down a ramp.* • The position and motion of an object can be changed by pushing and pulling. *The position and motion of objects can be changed by pushing or pulling. The amount of the change in position and motion is related to the strength of the push or pull (force). The force with which a ball is hit illustrates this principle.* • Sounds are caused by vibrating objects. *Vibration is a type of motion. Sound is produced by vibrating objects. The pitch of the sound can be varied by changing the rate of vibration.*	• Observing position des • Changes in position (motion) • Push • Pull • Drop • Vibration • Sound	*Students will:* • Investigate effect mass has on amount of pull required to start a light, flat container sliding across a level surface. Attach a spring scale to the container filled with a known mass (e.g., rocks, sand, washers, aquaria gravel). Pull on the container with the scale and record the scale reading at the point the container begins to slide (moves at least 1 centimeter). Repeat several times and average the data. Perform the same procedure with a variety of masses in containers and construct graphs showing the relationship of pull required to the mass contained. Formulate conclusions. Relate to experiences (e.g., pulling a sled with different people or different numbers of people). Extend activity by designing and conducting experiments to examine effect of various surfaces (e.g., carpet, tile, asphalt tabletop, concrete) have on force needed to make a container start moving. • Investigate sounds caused by vibrating objects. Design comparative studies to gather information on sound produced by vibrating (e.g., Plucked) rubber bands. Identify variables (e.g., Thickness, tension, length). Investigate to determine how variables influence sound produced when a rubber band is plucked. Use conclusions to design and construct a three or more stringed rubber band instrument that produces low, medium, and high pitches. Share and compare instruments. Discuss designs with the class.

Course/Grade 4th **Unit:** **Physical Science:** *Light, Heat, Electricity and Magnetism* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
A. How does light, magnetism, electricity, and heat affect my life?	• Light travels in a straight line until it strikes an object. Light can be reflected, refracted, or absorbed by objects. *Light travels in a straight line until is strikes an object. Light can be reflected by a shiny object, refracted by a lens, or absorbed by an object such as a dark surface.* • Heat can be produced in many ways and can move from one object to another by conduction. *Heat can be produced in many ways, such as burning or rubbing. One way heat can move from one object to another is by conduction. Some materials absorb and conduct heat better than others. For example, metal objects conduct heat better than wooden objects.* • Electrical currents move through electrical circuits. Electricity in circuits can produce light, heat, sound, and magnetic effects. *Electricity in circuits can produce light, heat, sound, and magnetic effects. Electrical circuits require a complete conducting path through which an electrical current can pass.* • Magnets attract and repel each other as well as certain kinds of other materials. *Magnets attract and repel each other, and magnets attract certain kinds of other materials (e.g., iron).*	• Light • Heat • Electricity – Definition of electricity – Static electricity – Electric current – Electric circuit – Simple circuit- battery, wire, light bulb, filament, switch, fuse) – Closed circuit – Open circuit – Short circuit – Conductors and insulators – Electromagnets – Electrical safety • Magnetism • Michael Farraday	*Students will:* • Experiment with light, noting changes as it is reflected and refracted. • Investigate spectra; discuss absorption. • Use batteries, bulbs, and wires to make bulbs light. Investigate ways to make light brighter. • Investigate how different materials affect the rate at which heat moves. Fill 3 different containers (e.g., styrofoam, paper cup, tin can, glass jar) with equal volumes of hot tap water. Measure and graph the temperature of water in each container over time as it cools. Place containers in a shallow pan of ice to accelerate cooling. Describe where the heat is going as the temperature of water decreases. Interpret data to develop working definitions of conductor and insulator. Examine commercial food packaging materials and explain which of their properties the manufacturer considered when they were selected for use. Design, construct and test an insulated thermos (one container inside another separated by an insulating material). Examine effectiveness of common materials (e.g., Popcorn, shredded paper, gravel, cereal) as insulators. Share and compare thermos designs. Design brochures for the other students in the school to inform them about ways they could pack their lunches to improve conditions of their food for lunch time. (WP—transactive) • Observe the behavior of charged materials and infer the cause of the behavior. Blow up two balloons. Tie a string to each and hang as shown in the picture below. Rub each balloon with the piece of nylon (or wool). Bring the balloons near each other. Observe what happens. Blow up two more balloons. Repeat using plastic wrap instead of the nylon. Bring one balloon rubbed with nylon close to one balloon rubbed with plastic wrap. Observe what happens. *(Continued next page)*

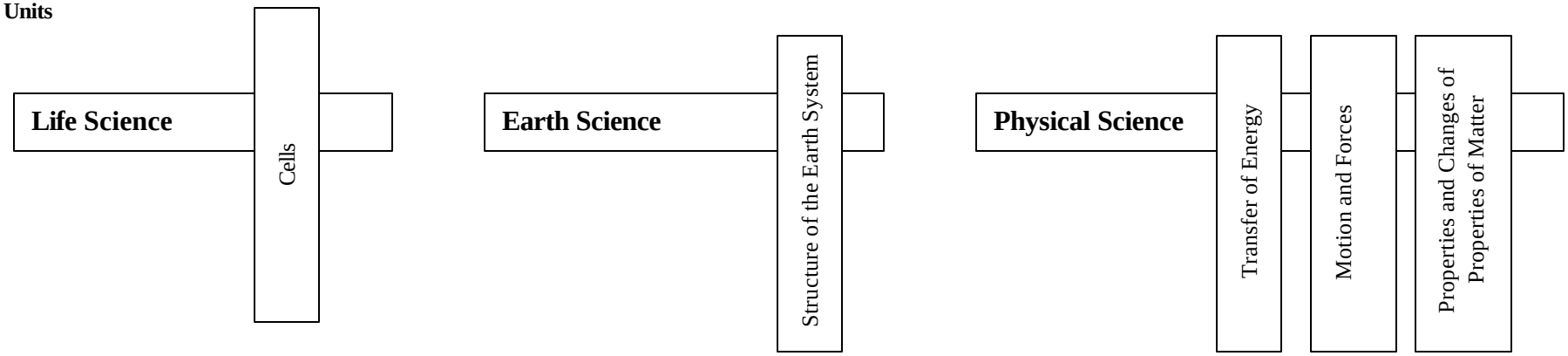
			• Draw diagrams to represent a closed electric circuit. Describe the path of the electricity from the time it leaves the battery until it returns to the battery. • Determine what is wrong with circuits (e.g., flashlight with missing battery or light bulb). Describe in science journal. • Investigate the flow of electricity. Create simple circuits using wire, battery, switch, and light source. Create drawings of open and closed surface. Investigate different kinds of circuits. • Create electromagnets with basic materials (battery, wire, nail). Test materials attracted to electromagnets. Compare magnet to peer's magnets. Discuss ways to create magnets that are more powerful. Analyze and research uses of magnets in common items (e.g., Motors). • Design experiments to determine the distance magnets can attract. Use a variety of objects (e.g., Paper clips, nails, washers). Record and analyze findings. Extend this activity by using different types of magnets to compare data and analyze findings. Create a system (e.g., Strongest to weakest) for categorizing various magnets in the classroom. • Explore the use of magnets in everyday life (e.g., trains, motors, microphones, speakers). Develop informational booklets on magnets and their uses. • Use the Internet or other resources to research the contributions of Michael Farraday to the world of electricity. Students can work in groups to prepare a mock interview of the scientist.

Fifth Grade Science Curriculum

Description

Fifth grade science will focus on Earth and Life sciences. This will prepare the students for their entrance into early middle school science curriculum. The students will gain a broader understanding of the community they live in, the world around them as well as their own body functions. They will also gain research skills and communication skills in the area of the arts. These experiences will increase their natural curiosity about science and allow them to explore science in their everyday experiences.

Units



Course Questions

To achieve our goals, the following questions were designed to be considered in the fifth grade.

A. How is science everywhere around you?
B. Why does science affect you and the world around you?

Course/Grade 5th **Unit:** **Earth and Space Science:** *Structure of the Earth System* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How are the characteristics of the atmosphere affected by the water cycle? 2. In what ways can human beings effect the Earth's systems? 3. Why should we study the atmosphere?	• Model the water cycle and how water dissolves minerals and gases and carries them to the oceans. *Water, which covers the majority of the Earth's surface, circulates through the crust, oceans and atmosphere in what is known as the water cycle. Water dissolves minerals and gases and may carry them to the oceans.* • Explore the characteristics of the atmosphere and how the water cycle affects the atmosphere, clouds, weather and climate. *Global patterns of atmospheric movement influence local weather. Oceans have a major effect on climate, because water in the oceans holds a great amount of heat.* • Investigate living organisms' effects on the earth system.	• Humidity • Evaporation, condensation precipitation ground water. • 4 layers of the atmosphere. • Air mass and pressure • Front • Hydrosphere • Ocean water and salinity • Water pressure • Tide and water level change • Current	*Students will:* • Make a poster that tells people about the properties of the earth's air and water, how they are polluted, and what people can do to stop the pollution. • Research a famous oceanographer or meteorologist or a marine biologist to discuss their contributions to their field. • Explore how the water cycle affects the atmosphere. Write articles describing the path of one drop of water as it moves through the water cycle. • Examine the role of science in predicting natural events such as earthquakes, tsunamis, tornados etc. • Read a literature book related to a natural atmospheric event such as The Night of the Twisters or Shark Beneath the Reef. • Examine components of water cycle. Research and construct physical models of local rivers' and streams' drainage patterns. Display models at local Agricultural Soil Conservation Service (ASCS) offices. (Environmental) • Investigate humans' effects on the atmosphere. Construct devises for collecting airborne particles. Collect data over several days. Produce written explanations, conclusions, and possible causes that are supported by data. Produce and write script for video to be broadcast on local cable TV network channel. (WP-Transactive)

Course/Grade 5th **Unit: Life Science:** *Cells* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How do cell parts work together? 2. Why do cells die and get replaced so quickly?	• Recognize relationship between structure and function (organ, whole organism, ecosystem) *All organisms are made of cells. Most organisms are single celled, others are multicellular.* • Model cells and recognize that cells carry on functions needed to sustain life. *Cells carry on the functions neede3d to sustain life. They grow and divide to produce more cells.*	• Cell parts • Cells make up the basic unit of life. • Different types of body cells. • Function of cells • Organized cells make up tissue • Organized organs make up a system • Organized tissues make up organs	*Students will:* • Create a model of a cell using some type of medium. • Using a template of some kind, students can identify all parts of the cells. • Use a toothpick to remove cells from their cheek to observe under the microscope. • Create a puppet show to explain how the different type of organelles work together in the cell. • Look into microscopes to identify different types of cells. • Examine elements used for classification (e.g., structure, function) of plants and animals. Compare body plans (e.g., segmentation, symmetry) and other feature (e.g., number of appendages) of animals. Compare features of plants (e.g., roots, stems, and nodes). Write articles comparing elements used for classification for local plants and animals. Submit articles to *Kentucky Native Plant Society.* (WP-Transactive) • Observe basic cell structure and construct cell models including cell parts. Compare cell models with abnormal (e.g., cancerous) cells.

Course/Grade 5th **Unit: Physical Science:** *Properties and Changes of Properties of Matter* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. What are the properties or the building blocks of matter? 2. How do the building blocks join together? 3. How does matter mix?	• Investigate characteristic properties of substances. *A substance has characteristic physical properties (density, boiling point, solubility) that are independent of the amount of the sample. A mixture of substances often can be separated into the original substances by using one or more of these characteristic physical properties*. • Examine chemical reactions between substances, recognize that the total mass remains the same and that substances are categorized by how they react. *The chemical properties of a substance cause it to react in predictable ways with other substances to form compounds with different characteristic properties.* • Recognize that elements do not break down during normal laboratory reactions and how elements combine to produce compounds. *Chemical elements do not break down during normal laboratory reactions such as heating, exposure to electric currents, or reaction with acids. Elements combine in many ways to produce compounds.*	• Acid /bases • Common elements • Compounds • Electrons • Ion • Matter and elements • Mixtures • Neutrons • Nuclear power • Periodic table and atomic number • Protons • Solutions	*Students will:* • Investigate properties of substances (color, hardness, melting and boiling point) organize into tables. Make iced tea then analyze the properties of the substances used to make iced tea. Produce consumer information pamphlets about properties of substances and mixtures of substances commonly found in homes. Distribute pamphlets to local home extension agents. (WP-Transactive) • Use an iron rich cereal such as Total to find the actual iron in the cereal. Placing the crunched up cereal in a bag, students will add water to the bag and then stir the cereal with the magnet. The iron will stick to the ends of the magnet. • Students will bring various metal objects to school to categorize into metals. They will identify the metal, atomic name and number. • Write a chemical formula for nuts and bolts. With a variety of nuts and bolts students will give each type a specific symbol. They will then create a variety of formulas using different combinations of pieces. • Observe that mass remains constant before, during, and following chemical reactions. Place balloon, small beaker with 15mL of water, and half effervescent tablet on balance and measure mass. Then place water and tablet in balloon, seal balloon, allow water and tablet to react while on balance, and continue to monitor mass. Report observations and explanations. Base explanations on evidence, logic, and scientific knowledge. • Recognize that elements do not break down. Produce word equations for chemical reactions. Identify starting substances and substances produced by their constituent elements (e.g., paper [carbon] plus oxygen yields carbon dioxide). Display equations on classroom bulletin board.

Course/Grade 5th **Unit: Physical Science:** *Motion and Forces* **Suggested Length:**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How can forces on objects cause change in the motion of the object? 2. How do machines produce their power and how do forces produce movements?	• Describe, measure and represent an object's motion *The motion of an object can be described by its relative position, direction of motion, and speed. That motion can be measured and represented in a graph.* • Investigate balanced or unbalanced forces and the effects on an object's motion. An object at rest or maintains a constant speed and direction of motion unless an unbalanced force acts on it *When an unbalanced force acts on an object, the change in speed and or direction depends on the size and the direction of the force.*	• Mass and comparing mass • Mass and comparing weight • Weight • Transmit force • Gravity • Scales and balances • Friction • Law of Conservation of Momentum • Newton's Laws of Motion • Vectors • Simple machines • Buoyancy/ up thrust • Archimedes Principle	*Students will:* • Examine the various machines used in ancient times to build some of the large monuments. They will prepare a small model depicting its use. • Write a report on the contributions of Archimedes, Aristotle, Galileo, Newton and Einstein to the world of motion. • Bring to class evidence of simple machines at work. They will be displayed and discussed. "How is our everyday life affected by simple machines?" • Students will build a container to hold a regular egg. The egg will be dropped from a height of 9 feet to see if the container will protect it from breaking. Gravity will be discussed. • Measure "distance traveled", "time for trip", and mathematically calculate average speed for several real trips (e.g., walk or run around school building, ride bike from home to store). Calculate "distance" and "time" data numerous times during trips, graph distance versus time for each trip, and use slope of line to find average speed for each trip. Produce a written explanation of two ways to determine average speed. Create a new spreadsheet to represent data. (Technology) • Investigate and compare systems that balanced forces (e.g., toy car sitting on table) and systems with unbalanced forces (e.g., toy car moving down slope). Design experiments to investigate influence of different slopes of motion of toy cars. Report results of this inquiry lab and describe the forces on toy cars that having increasing speeds. Distribute reports to local boy scouts before pine box derby. (WP-Transactive)

Course/Grade 5th **Unit: Physical Science:** *Transfer of Energy* **Suggested Length:**

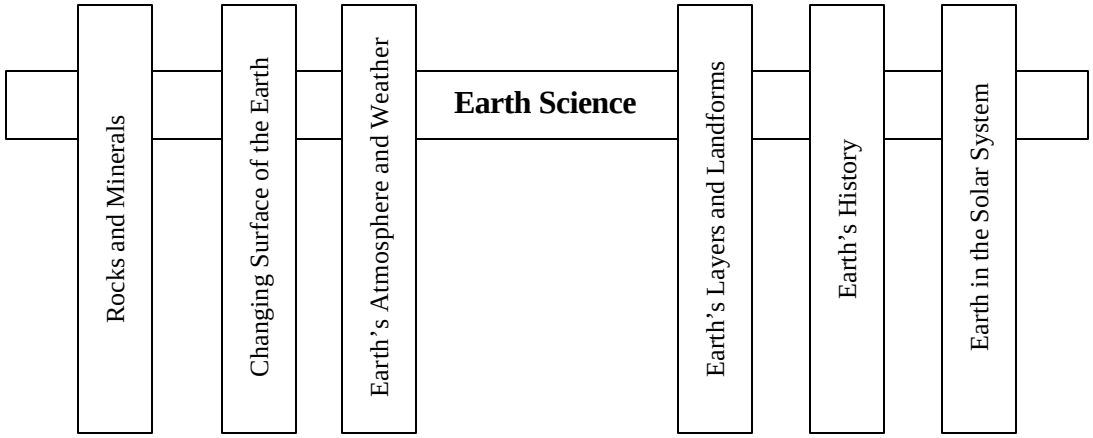
Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How does energy move from one place to another? 2. What are the forms of wave energy?	• Demonstrate that energy is a property of substances. *Energy is a property of many substances and is associated with heat, light, electricity, and sound. Energy is transferred in many ways.* • Observe forms of energy transfer (vibration) Energy is a property of many substances and is associated with heat, light, electricity, and sound. Energy is transferred in many ways. • Observe the ways heat can move. Heat energy moves in predictable ways, flowing from warmer objects to cooler ones, until both objects reach the same temperature. • Recognize that the Sun's energy arrives as light with a range of wavelengths and explore how light interacts with matter. Light energy interacts with matter by transmission (including refraction), absorption, or scattering (including reflection). *The sun is a major source of energy for changes on the Earth's surface. The sun loses its energy by emitting light. A tiny fraction of that light reaches earth, transferring energy from the sun to the earth.* Observe how electrical circuits transfer electrical energy. *Electrical circuits provide a means of transferring electrical energy when heat, light, sound and chemical changes are produced.*	• Sound energy • Light energy • Electromagnetic • Wavelengths frequency and amplitude • Decibels and vibration • Reflection, refraction transparent, translucent and opaque • Concave and convex surfaces • Spectrums	*Students will:* • Based on their learning style, children will create a presentation depicting one or more of the ways energy travels. (a piece of art using light or sound, a dance that shows how light or sound reacts to different materials). • Construct electrical circuits to show energy transfer. • Burn pieces of paper to observe heat, light and sound that is produced. • Take photographs or videos of different substances that possess energy such as moving carts (kinetic energy), steam (thermal energy), carts on platforms (potential energy), and apple (chemical energy). Present finds to PTA or student council. (Technology) • Observe Sun's energy. Use spectroscopes, prisms, diffraction gratings to observe various wavelengths of light produced by the Sun. Produce colored charts comparing wavelengths from the Sun to wavelengths from other light sources (e.g., incandescent, fluorescent). Use colored charts for class activity identifying light from unknown sources. Indirectly observe heat moving. Measure temperature of glass of water from water faucet, measure temperature of freezer compartment of refrigerator then place ice cubes into a glass of water and measure temperature ever 5 minutes for next 60 minutes. Graph temperature verses time and us graph to determine final temperature of mixture. Produce explanations of heat energy moved from warmer objects to cooler objects and describe variables that affected how much heat energy was transferred. Produce brochures to be distributed to homeowners by home extension agents about moving heat energy in homes.

Middle School Science Curriculum
Earth Science – Grade 6

Description

In grade six students will focus on Earth Science. This will allow the students to develop an understanding of the Earth and solar system. Additionally, their study of the earth's history provides some evidence about its geological activity. The understanding that the students gain from their observations in grade K-4 provides motivation and the basis which they can construct a model that explains the visual and physical relationship among earth, sun, moon, and the solar system. Through out the school year students will:

- Refine and refocus questions that can be answered through scientific investigation combined with scientific information.
- Use appropriate equipment, tools, techniques, technology, and mathematics to gather, analyze, and interpret scientific data.
- Use evidence (e.g., computer models), logic, and scientific knowledge to develop scientific explanations.
- Design and conduct scientific investigations.
- Communicate (e.g., write, graph) designs, procedures, observations, and results of scientific investigations.
- Review and analyze scientific investigations and explanations of other students.
- Describe how science helps drive technology and technology helps drive science, because perfectly designed solutions do not exist, technological solutions have intended benefits and unintended consequences.
- Describe the individual's roles and responsibilities in the following area: changes in populations, resources and environments including ecological crises and environmental issues, natural hazards, science and technology in society, and personal and societal issues about risks and benefits.
- Demonstrate the role science plays in everyday life: past, present, and future. Science is a human endeavor. Men and women of various social and ethnic backgrounds engage in activities of science (to include careers in science). Scientists formulate and test their explanations of nature using observations, experiments, and theoretical and mathematical models. It is part of scientific inquiry to evaluate the results of scientific investigations, experiments, observations, theoretical models, and the explanations proposed by other scientists.



Course Questions:

A. What methods do scientists use to learn about the components and structure of the Earth?
B. How does Earth Science affect everyday life?

Course/Grade **6th** **Unit: Earth and Space Science:** *Rocks and Minerals* **Suggested Length:** **6 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How are physical characteristics used to identify minerals? 2. How does one rock change into another? 3. How are the different rocks classified?	• Demonstrates the rock cycle (e.g., weathered rocks produce soil, weathered rocks are often recrystallized into new rock) and examine characteristics of soils. • Investigate the structure of the Earth system (e.g., rock cycle). *Materials found in the lithosphere and mantle is changed in a continuous process called the rock cycle.*	• Minerals • Mineral Identification • Use of Minerals • Rock cycle • Igneous Rocks • Metamorphic Rocks • Sedimentary Rocks	*Students will:* • Grow sugar and salt crystals. • Identify unknown mineral samples. • Write a paragraph explaining the importance of a mineral resource to an area's economy. • Draw rock cycle chart. • Collect rock, develop classification system, and compare system to other classification systems (environmental). • Create a power point presentation on the different types of rocks (technology). • Write a paragraph explaining how the eruption of various volcanoes affects living things. • Construct a 3D model of mineral shapes. • Construct a model of the different types of rocks.

Course/Grade 6th **Unit: Earth and Space Science:** *Changing Surface of the Earth* **Suggested Length:** **6 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How is Earth affect by the weathering of water? 2. Why is the water cycle important? 3. Why are the components of the river system important?	• Demonstrate the rock cycle (e.g., weathered rocks produce soil, weathered rocks are often recrystallized into new rock) and examine characteristics of soils. *Soil consists of weathered rocks and decomposed organic material from dead plants, animals, fungi, protests, and bacteria. Soils are often found in layers, with each having a different chemical composition and texture.* • Examine Earth's processes (e.g., erosion, deposition) and catastrophes (e.g., asteroid impact). *The Earth's processes we see today, include erosion, movement of lithospheric plates, and changes in atmospheric composition, are similar to those that occurred in the past. Earth's history is also influenced by occasional catastrophes such as the impact of asteroids or comets.* • Investigate the structure of the Earth system (e.g., lithosphere, rock cycle, water cycle, weather, climate). *Water, which covers the majority of the Earth's surface, circulates through the crust, oceans, and atmosphere in what is known as the water cycle. Water dissolves minerals and gases and may carry them to the oceans.*	• Weathering • Soil • Running Water • Erosion • Glaciers • Wind • Water Cycle • River system	*Students will:* • Draw a water cycle chart. • Collect soil samples and identify the different particles. • Write a story explaining a day in the life of a water droplet. Make sure to discuss all parts of the water cycle. • "Glacier Grooving" Activity. Take a large block of ice and drag it through a pan of sand, pebbles, and dirt. To see how glaciers may have affected the earth. • Design an experiment to show land erosion. • Conduct an experiment to show if different types of soil affect movement of water. (e.g., clay, sand, and gravel) • Select a Kentucky river and investigate its geography, water quality, aquatic life, and importance to community. Create a brochure to attract enthusiast to the river. (WP-transactive) (environment) • Investigate river characteristics (e.g., sandbars, riffles, alluvial fans, and deltas). Develop a multimedia presentation to present to the class that describes how wind, pressure, and gravity move river water and its components to produce landforms. (technology) • Examine process of erosion on Earth surfaces. Design and conduct experiments to investigate erosion. Create environscapes from local communities using soil samples found there and simulate possible effects erosion would have on environscapes. Use small fans and dripping water to simulate effects of erosion caused by wind and rain. Use results of investigation to write articles on effects of erosion. (WP-transactive) *(Continued next page)*

			• Investigate factors that lead to the Dust Bowl of the 1930's. Interview soil conservation specialists and farmers about soil conservation techniques. Discuss possibilities of another Dust Bowl. Write articles for farmers detailing advantages and disadvantages of soil conservation methods. (WP-transactive) • Write a series of postcards in which they describe what the soil is like in different climates. • Take pictures of different types of weathering and give descriptions of the weathering. (environment and technology)

Course/Grade 6th **Unit: Earth and Space Science:** *Earth's Atmosphere and Weather* **Suggested Length:** 6 Weeks

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How can we observe the effects of the sun's energy on the Earth's surface and atmosphere? 2. How do climate and weather influence ecosystems? 3. How did the ocean form	• Identify phenomena (e.g., growth of plants, wind, water cycle, ocean currents) on the Earth caused by the sun's energy. *The water cycle, winds, ocean currents, and growth of plants are affected by the Sun's energy.* *The gravitational pull of the sun and moon on Earth's oceans is the major cause of tides.* • Investigate the structure of the Earth's system (e.g., lithosphere, rock cycle, water cycle, weather, climate). *Earth is surrounded by a relatively thin blanket of air called the atmosphere. The atmosphere is a mixture of nitrogen, oxygen, and trace gases that include water vapor. The atmosphere has different properties at different elevations.* *Global patterns of atmospheric movement influence local weather. Oceans have a major effect on climate, because water in the oceans holds a large amount of heat.*	• Atmosphere • Ozone layer • Sun energy • Air movement • Precipitation • Thunderstorms • Tornadoes • Hurricanes • Climate • Ocean currents • Ocean waves and tides	*Students will:* • Model convection in the atmosphere and ocean. (Have a beaker of water and drop some food color into the beaker.) • Create a map of ocean current patterns. • Investigate density of different substances and examine how density differences causes winds and ocean currents. • Demonstrate how landforms (e.g., mountains, river valleys) affect annual precipitation rates. • Interpret and draw weather maps. (Technology) • Use the Internet to investigate global temperature. • Make a chart showing rainfall in an area. • Prepare a class skit portraying a meteorologist. (WP-Literary) • Create a model of a tornado. • Create a spreadsheet to show precipitation in different areas over a range of time. (Technology)

Course/Grade 6th **Unit: Earth and Space Science:** *Earth's Layers and Landforms* **Suggested Length:** **6 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How do the plate boundaries affect the Earth? 2. Why do earthquakes and volcanic eruptions occur?	• Model Earth's layers. *The Earth is layered. The lithosphere is the thin crust of the Earth. Lithospheric plates move slowly in response to movement in the mantle. There is a dense core at the center of the Earth.* *Landforms are a result of a combination of constructive and destructive forces. Constructive forces include crustal deformation, volcanic eruption, and deposition of sediment, while destructive forces include weathering and erosion.*	• Earth's layers • Continental drift • Plate tectonics • Earthquakes • Volcanoes • Landforms	*Students will:* • Make a diagram of the Earth's layers • Construct physical model (e.g., relief map) that shows crustal plate movement, earthquakes, volcanic eruptions, and mountain building. • Write letters to obtain samples of material that erupted from a volcano. (To do classifying of the material) • Construct models of the three different volcanoes. • Use an earthquake wave travel time graph to determine the location of actual earthquake epicenters • Create a puzzle on the plates of the Earth. • Construct models of and identify the different landforms. • Write a travel guide that describes the experiences of traveling Earth's different layers. (WP-transactive) • Create a poster to promote earthquake safety. • Use the internet to investigate earthquakes around the world www.imsa.edu (technology) • Write a paragraph explaining how the eruption of various volcanoes affects living things.

Course/Grade **6th** **Unit: Earth and Space Science:** *Earth's History* **Suggested Length:** **6 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. What evidence can be found that the Earth has changed over time? 2. How do you tell what rock is the oldest?	• Examine evidence (e.g., fossils) for changes in life and environmental conditions. *The Earth's processes we see today, including erosion, movement of lithospheric plates, and changes in atmospheric composition, are similar to those that occurred in the past. Earth's history is also influenced by occasional catastrophes such as the impact of an asteroid or comet.* • Analyze Earth's history (e.g., Earth processes, catastrophes, evidence for changes). *Fossils provide important evidence of how environmental conditions and life have changed.*	• Fossils • Ages of Rock • Geological Time Scale	*Students will:* • Investigate changes in life and environmental conditions by collecting fossils. Observe structure of fossils and rock layers in which fossils were found. • Create a diorama of past environments in which organism lived. • Investigate geologic time. Construct a model or picture that shows the divisions of geologic time on a time line. • Date a rock layer in land features. • Design a model and carry out an experiment to show radioactive decay can be used to determine the absolute age of a rock containing radioactive isotopes. • Determine the relative order of events by interpreting geologic cross sections. • Design a model of a fossil.

Course/Grade 6th **Unit: Earth and Space Science:** *Earth in the Solar System* **Suggested Length:** **6 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. Why can I live on Earth and not other planets? 2. How do the rotation and revolution of the Earth affect climate and ecosystems? 3. Why do I see just part of the moon and not the entire moon? 4. How is life affected by technologies developed for space exploration?	• Model the solar system (e.g., structure, number of planets) and its components (e.g., planets, moons, asteroids). *Earth is the third planet from the Sun in a system that includes the moon, the Sun, eight other planets and their moons, ands smaller objects such as asteroids and comets. The Sun is an average star, is the central and largest body in the solar system.* • Model motion (e.g., orbits) of astronomical objects (e.g., planets, constellations, galaxies) to explain phenomena such as days, years, and eclipses. *Most objects in the solar system are in regular and predictable motion. Those motions explain such phenomena as the day, the year, phases of the moon, and eclipses.* • Examine Earth's processes and catastrophes (e.g., asteroid impact). *The Earth's processes we see today, including erosion, movement of lithospheric plates, and changes in atmospheric composition, are similar to those that occurred in the past. Earth's history is also influenced by occasional catastrophes such as the impact of an asteroid or comet.* • Investigate the Earth as a component of the solar system (e.g., Sun, planets, motion). *Sun is the major source of energy for Earth.* *Seasons result from variation in the amount of the Sun's energy hitting Earth's surface.* • Recognize that gravitational force causes motion in the solar system. *Gravity is the force that keeps the planets in orbit around the sun and governs the rest of the motion in the solar system*	• Earth • Seasons • Day (rotation) • Year (revolution) • Moon Phases • Eclipses • 9 Planets • Stars • Constellations • Sun • Galaxies	*Students will:* • Examine characteristics of the Planets. • Model how Earth's tilt on its axis and its revolution around the sun creates seasons. • Construct scale model of the solar system including planets, their moons, and the sun. • Construct a model a constellation. • Investigate phenomena on Earth's surface caused by the sun's energy. Design and conduct an experiment to show how seasons are caused by the tilt of the Earth's axis. Hold flat surfaces at different angles with respect to light sources and measure the resulting surface temperature. Communicate results by producing temperature verses time graphs for each surface. Use observation to produce articles showing the effect of Earth's tilt on passive homes. (WP-transactive) • Research new technologies that enhance the probability of vacations in space. Design vacation packages for travel in space. • Conduct an experiment to show the different phases of the moon. • Conduct an experiment to show the impact of asteroids on the Earth and Moon's surface. Take a plate of flour or cornstarch, have the students drop a small rock to see the affects.

Middle School Science Curriculum
Life Science-Grade 7

Description

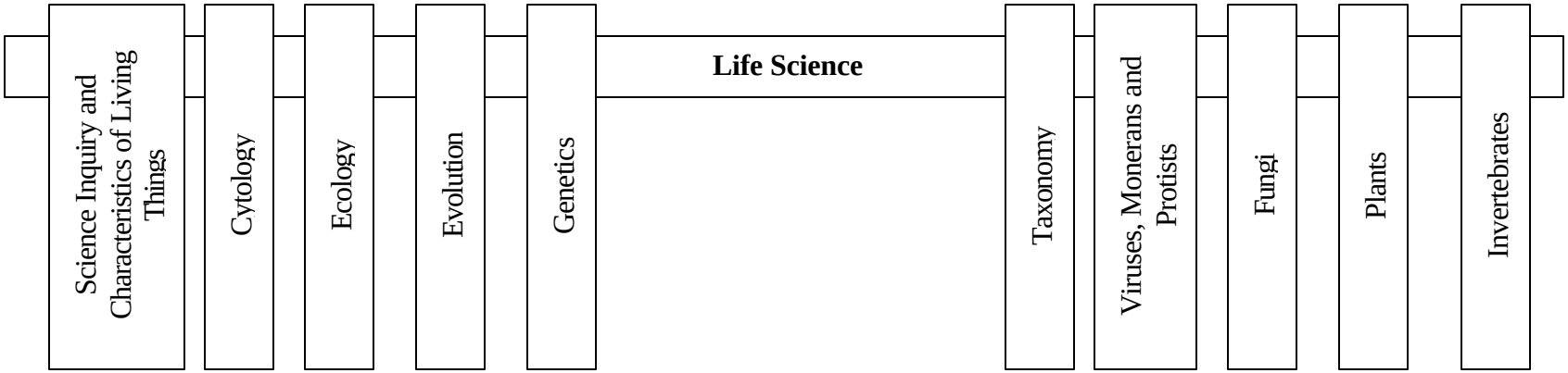
In grade seven students will focus on Life Science. Students will establish a foundation for the concepts studied in high school biology. The fundamental concepts emphasized are: scientific ways of thinking, reproduction and heredity, diversity and adaptations of organisms, population and ecosystems, structure and function in living systems and, regulation and behavior.

Academic Expectations

2.1 Scientific Ways of Thinking and Working

Students will:

- Refine and refocus questions that can be answered through scientific investigation combined with scientific information
- Use appropriate equipment, tools, techniques, technology, and mathematics to gather, analyze, and interpret scientific data
- Use evidence (e.g., computer models), logic, and scientific knowledge to develop scientific explanations.
- Design and conduct scientific investigations.
- Communicate (e.g., write, graph) designs, procedures, observations, and results of scientific investigations.
- Review and analyze scientific investigations and explanations of other students.



Course Questions

A. How is science inquiry used to solve problems in life science?
B. How is the study of life science relevant to the individual as well as society?

Course/Grade 7th **Unit: Life Science:** *Science Inquiry and Characteristics of Living Things* **Suggested Length:** **2 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. What are the features of living things? 2. Where does life come from? 3. What is Science? 4. What are the methods scientists use to solve problems? 5. How are things measured? 6. What is the impact of science on our lives?	• Investigate how organisms obtain and use resources, grow, reproduce, and maintain stable internal conditions. *All organisms must be able to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment.* *Regulation of an organism's internal environment involves sensing the internal environment and changing physiological activities to keep conditions within the range required to survive. Maintaining a stable internal environment is essential for an organism's survival.* • Identify and refine questions that can be answered through scientific investigations combined with scientific information. *Refine and focus questions that can be answered through scientific investigation combined with scientific information.* • Use appropriate equipment (e.g. glassware, meter sticks, calculators, etc) *Use appropriate equipment, tools, techniques, technology, and mathematics to gather, analyze, and interpret scientific data.* • Review and analyze scientific investigations and explanations of other students. • Examine the interaction between science and technology.	• Features of life • Needs of living things • Interaction of living and non-living things • Spontaneous generation • Biogenesis • Scientific work of Redi, Spallanzani, Pasteur, Oparin, Miller. • Scientific method • SI units of measurement • Lab Safety • Technology	*Students will:* • Design and conduct experiments using the scientific method (e.g., diapers, paper towel absorbency, seed growth) • Critique other students experimental designs to determine if there are discrepancies in the experimental design • Be able to identify living and non-living things explaining the reasoning for classification. • Use appropriate equipment to measure length, mass, volume, and density of items in SI units. • Compete in Metric Olympics • Respond and evaluate student setups of experiments resulting from teacher-suggested observations. • Research a field of biological sciences and careers in that field. Conduct interviews where appropriate to obtain information. Report to class on the career using multimedia presentation, posters, brochures or video. (WP-Transactive)

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	• Describe the effects of science and technology on society. *Describe how science helps drive technology and technology helps drive science. Because perfectly designed solutions do not exist, technology solutions have intended benefits and unintended consequences* • Use science to evaluate the risks and benefits to society for common activities *Describe the individual's roles and responsibilities in the following areas: changes in populations, resources and environments including ecological crises and environmental issues, natural hazards, science and technology in society, and personal and societal issues about risks and benefits.* .		

Course/Grade 7th **Unit: Life Science:** *Cytology* **Suggested Length:** **4 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. What is a cell? 2. What technology is used to study cells? 3. What comprises the structure of a cell? 4. How do animal and plant cells differ? 5. How are cells organized? 6. What problems can occur in organ transplants? 7. What is the relationship between chemistry and life science? 8. What is the difference between organic and inorganic compounds? 9. How do materials get into and out of cells? 10. What is the source of a living thing's energy? 11. What is the difference between a producer and a consumer?	• Investigate structure (e.g. cells, tissues, organs) and function (e.g. growth, muscular function, digestion) in living systems. *Specialized cells perform specialized functions in multicellular organisms. Groups of specialized cells cooperate to form tissues. Different tissues are, in turn, grouped together to form larger units called organs. Each type of cell, tissue and organ has a distinct structure and set of functions that serve the organism.* *Cells have particular structures that underlie their function. A membrane that separates it from the outside world surrounds every cell. Inside the cell is a concentrated mixture of thousands of different molecules that form a variety of specialized structures. These structures carry out specific cell function.* • Analyze reproduction (e.g., asexual, sexual) *Reproduction is a characteristic of all living systems and is essential to the continuation of every species. Some organisms reproduce asexually, others reproduce sexually, including humans and plants, male and female sex cells carry genetic information unite to begin the development of a new individual.* • Use appropriate equipment (e.g., microscope) *Use appropriate equipment, tools, techniques, technology, and mathematics to gather, analyze, and interpret scientific data.* • Living structures at all levels of organization demonstrate the complementary nature of structure and function. Important levels of organization for structure and function include cells, tissues, organs, organ systems, organisms (e.g., bacteria, protists, fungi, plants, animals) and ecosystems.	• Active transport • Asexual reproduction • Atoms • Biodegradable items • Carbohydrates • Cell theory • Cells • Cellular respiration • Chromosome • Compound light microscope • Consumer • Diffusion • Egg • Electron microscope • Equilibrium • Eukaryotes • Fermentation • Fertilization • Gene • Lipids • Matter • Meiosis • Metabolism • Mitosis • Mutation • Nucleic acids • Organ systems • Organelles • Organism • Organs • Osmosis • Passive transport • Photosynthesis • Producer • Prokaryotes	*Students will:* • Observe the chicken egg as an example of a large single cell. • Practice correct use of the compound microscope (e.g., parts, magnification, par focal, care) • Model the organelles present in plant and animal cells by drawings on poster board using colored pencils and construction paper. • Model a cell using different media (e.g. clay, gelatin, polystyrene) • Plan, illustrate, and present analogies to assigned organelles. (E.g., nucleus is analogous to the manager of a company) • Observe and report findings of living plant cells (Elodea) and animal cells (human cheek cells) • Given an onion plant, design an experiment that will determine its parts and explain how they work together. • Conduct an experiment to Observe and data to write a lab report describing diffusion and osmosis. • Design and create an aquarium in which some organisms demonstrate photosynthesis and other ones demonstrate cellular respiration. • Use yarn to draw and illustrate the various steps of mitosis. • Illustrate the two meiotic divisions to create a flipbook. • Observe and illustrate mitotic stages of the onion tip (plant) and whitefish (animal) using the compound microscope • Creatively model the DNA molecule using construction paper. • Demonstrate DNA transcription using prepared cutouts. *(Continued next page)*

12. How are photosynthesis and cellular respiration alike and different? 13. How do cells grow and divide? 14. What is the difference between mitosis and meiosis? 15. How do cells reproduce new organisms? 16. What is the difference between asexual and sexual reproduction? 17. How does fertilization occur? 18. What are the components of the DNA and RNA molecules? 19. How does DNA copy itself? 20. How does DNA transcribe a message and enable the making of a protein? 21. How can mutations occur?	• Model cells and recognize that cells carry out functions needed to sustain life. All organisms are composed of cells, the fundamental unit of life. Most organisms are single cells; other organisms, including plants and animals are multicellular. *Cells carry on the many functions needed to sustain life. They grow and divide, thereby, producing more cells. This requires that they take in nutrients, which they use to provide energy. For the work that cells do and to make the materials that a cell or an organism needs.* *Specialized cells perform specialized functions in multicellular organisms. Groups of specialized cells cooperate to form tissues. Different tissues are, in turn, grouped together to form larger units called organs. Each type of cell, tissue and organ has a distinct structure and set of functions that serve the organism.*	• Proteins • Replication • Scientists work with cells; Hooke, VanLeeuwenhoek, Schleiden, Schwann, Virchow • Sexual reproduction • Sperm • Stereoscopic microscope • Tissues • Transcription • Zygote	• Demonstrate Protein synthesis by participating in a relay race where every leg of the team must encode/decode individual steps of protein synthesis.

Course/Grade 7th **Unit: Life Science:** *Ecology* **Suggested Length:** 5 Weeks

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. What is ecology? 2. In what ways do organisms interact with each other? 3. In what ways do nonliving factors affect organisms in an ecosystem? 4. How do organisms affect their environment?	• Investigate and analyze population and ecosystems. • Investigate energy flow in ecosystems *A population consists of all individuals of a species that occur together at a given place and time. All populations living together and the physical factors with which they interact compose an ecosystem.* *Population of organisms can be categorized by the function they serve in an ecosystem. Plants and some microorganisms are producers because they make their own food. All animals, including humans, are consumers, and obtain their food by eating other organisms. Decomposers, primarily bacteria and fungi, are consumers that use waste materials and dead organisms for food webs identify the relationship among producers, consumers and decomposers in an ecosystem.* • Recognize how science is used to understand changes in populations, issues related to resources, and changes in environments. *Describe the individual's roles and responsibilities in the following areas: changes in populations, resources and environments including ecological crises and environmental issues, natural hazards, science and technology in society, and personal and societal issues about risks and benefits.* • Investigate living organisms' effects on the Earth system. *Describe the individual's roles and responsibilities is the following areas: changes in population, resources and environments including ecological crises and environmental issues, natural hazards, science and technology in society, and personal and societal issues about risks and benefits.*	• Abiotic Factors • Biomes • Biosphere • Biotic Factors • Carbon Cycle • Carnivores • Climax community • Community • Competition • Conservation • Consumers • Decomposers • Ecosystem • Energy Pyramid • Food Chain • Food Web • Green house effect • Habitat • Herbivores • Limiting Factor • Natural resources • Niche • Nitrogen Cycle • Nonrenewable • Omnivores • Pioneer species • Pollution • Population • Population Density • Predator/Prey • Preservation • Producers • Recycling Autographs, heterotrophs and trophic levels) Renewable	*Students will:* • Design and carry out an investigation to determine if populations in a closed ecosystem change over time. Using dehydrated algae from a pond determine if factors such as food, space, and competition from other organisms limit the growth of a population. • Analyze 2000 census data and calculate the population density of Ft. Thomas and compare it to other cities in Kentucky (or State-vs. -State). • Design a food web by displaying the foods used to produce a typical pizza or typical evening meal. Each item will be identified as a producer, consumer or decomposer. Analyze the humans' position in an energy pyramid showing the humans as primary and secondary consumers. Discuss and analyze different human diets and how it relates to efficient energy use. • Investigate and illustrate a food web for organisms in your area. Analyze the importance of the food web and how human activity dis turbs this food web. Use this information to argue for or against this activity. (Exp: Use of pesticides, herbicides, real estate development or pet control). (WP-Transactive) • Design dioramas of the six major biomes using cooperative group learning. Identify the location of the major land biomes. Describe the climate, dominant plant types and characteristic animals adapted to each biome. • Investigate and design water ecosystem using aquariums and live organisms and distinguish between the requirements for a marine and freshwater ecosystems. Examine and analyze the limiting factors present in these ecosystems. *(Continued next page)*

	• Observe populations and determine the function organisms serve in an ecosystem A population consists of all individuals of a species that occur together at a given place and time. All populations living together and the physical factors with which they interact compose an ecosystem. (SC-M 3.5.1) *Populations of organisms can be categorized by the function they serve in an ecosystem. Plants and some microorganisms are producers because they make their own food. All animals, including humans, are consumers and obtain their food by consuming other organisms. Decomposers, primarily bacteria and fungi, are consumers that use waste material and dead organisms for food. Food webs identify the relationship among producers, consumers, and decomposers in an ecosystem. (SC M 3.5.2)* • Investigate factors (abiotic and biotic) that affect the number of organisms an ecosystem can support *The number of organisms an ecosystem can support depends on the resources available and abiotic factors. Given adequate biotic and abiotic resources and on diseases or predators, populations (including humans) increase at rapid rates. Lack of resources and other factors, such as predation and climate, limit the growth of populations in specific niches in the ecosystem. (SC M 3.5.4)*	• Species • Succession • Symbiosis • Water Cycle	• Investigate the use of a composting bin and determine which substances found in garbage are biodegradable and which are nonbiodegradable. Analyze the active organisms in the decompositions process. Use this information to write a feature article on composting. (WP-Transactive) • Investigate the pH of local water sources (rain, pond, stream and river) Compare and analyze data from each water source. Explore the possible explanation of any difference's • Investigate adaptations of moths (camouflage) to analyze the usefulness of adaptation for survival. Design and then display moths made from paper to match a specific location in the classroom i.e. desktop, bulletin board, and chalk tray. Identify and analyze those likely to survive by sending out student predators (bats) to find the hidden moths. • Investigate the regrowth (succession) of a newly disturbed area of land (Construction Site) near school. Collect data on numbers and types of plants (organisms) that colonize the disturbed land. Record data using photo images and written documentation. Analyze the data over time to determine the changes that take place in the ecosystem.

Course/Grade **7th** **Unit: Life Science:** *Evolution* **Suggested Length:** **2 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. What is the theory of evolution? 2. What evidence exists to support evolution? 3. How fast does evolution occur? 4. What are some causes of extinction? 5. How can endangered species be saved from extinction? 6. What is the geological time scale and how are fossils dated? 7. What is the evolutionary history of humans?	• Examine evidence (e.g., fossils) for changes in life and environmental conditions. *Fossils provide important evidence of how environmental conditions and life have changed.* • Investigate unity among organisms. *Biological change over time accounts for the diversity of species developed through gradual processes over many generations. Biological adaptations include changes in structure, behaviors, or physiology that enhances survival and reproductive success in a particular environment.* • Investigate biological adaptation and extinction. *Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to allow its survival. Extinction of species is common and most of the species that have lived on Earth no longer exist.*	• Species • Evolution • Natural selection • Variation • Population • Gradualism • Punctuated equilibrium • Fossils • Sedimentary rock • Relative dating • Radioactive elements • Homologous structures • Vestigial structures • Embryology • Extinction • Endangered species • Primates • Hominids • Homo sapiens	*Students will:* • Demonstrate the process of natural selection by using newspaper and black and white cutouts. Analyze how this process has happen and continues to happen by examining organisms such as moths. • Use pennies to demonstrate radioactive decay and use this model to determine how a radioactive element can be used to determine a fossil's age. • Model the evolutionary history of 40 different animal-like characters by placing them in appropriate lineage. • Research the disappearance of the dinosaurs. Produce a presentation or written report on the theories related to their disappearance. (WP-Transactive) • Construct a time line of the existence of Earth using adding machine tape. • Research/report on the Scope's trial. Produce a skit documenting the famous trial. • Produce an editorial comparing the Theory of Evolution and Creationism. • Participate in a debate on Creationism –vs.- The Theory of Evolution.

Course/Grade 7th **Unit: Life Science:** *Genetics* **Suggested Length:** 3 Weeks

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. What is genetics? 2. How are inherited traits passed from one generation to the next? 3. What is the importance of genetics in your life?	• Investigate traits, heredity, and genes *Every living organism requires a set of instructions for specifying its traits. This information is contained in genes located in chromosomes of each cell. Heredity is the passage of this instruction from one generation to another.* • Analyze reproduction (e.g. asexual and sexual) and heredity (e.g. genetic information and genetic traits. *Reproduction is a characteristic of all living systems and is essential to the continuation of every species. Some organisms reproduce asexually, others reproduce sexually. In species that reproduce sexually, including humans and plants, male and female sex cells carrying the genetic information unite to begin the development of a new individual.* • In all organisms and viruses, the instruction for specifying the characteristics are carried in nucleic acids. The chemical and structural properties of nucleic acids determined how the genetic information that underlies heredity is both encoded in genes and replicated. *Multicellular organisms, including humans, form from cells that contain two copies of each chromosome. This explains many features of heredity. Transmission of genetic information through sexual reproduction to offspring occurs when male and female gametes that contains only one representative from each chromosome pair unite.*	• Alleles • Chromosome • DNA • Dominant • G. Mendel • Gene • Genetic engineering • Genetics • Genome • Genotype • Heredity • Heterozygous • Homozygous • Incomplete dominance • Multiple alleles • Mutation • Pedigree • Phenotype • Polygenic inheritance • Punnett Square • Recessive • RNA • Sex-linked traits • Transgenetic organisms	*Students will:* • Build a model of DNA out of simple materials (i.e. clay and tooth picks) • Complete a lab on easy to observe human variations (look at various genetic traits such as hair color and eye color). • Use Punnett squares to demonstrate inheritance patterns and to help determine probability of inheritance. • Complete a Pedigree chart to determine the inheritance pattern over several generations of organisms. • Research human genetic disorders and produce an informational brochure for distribution at local doctors office. • Students create a family tree using photos of their family. Write a family newsletter describing similarities and differences among members of the family. (Obtain pictures by writing family members for help on the project). • Research the Human Genome project write an editorial on the importance and consequence of this project. • Survey the class for the presence of common traits (height, hair color, eye color…) and create a graph and visual representation (life size cutout of the average student) of your data. • Research the history of genetic from G. Mendel to the present and create a wall size time line poster for the classroom. • Complete a lab to compare expected results observed using Punnett squares and how the principles of heredity are related to chance (probability) (red beans/white beans)

Course/Grade **7th** **Unit: Life Science:** *Taxonomy* **Suggested Length:** **2 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. What is taxonomy? 2. Why do scientists classify living things and why is that important? 3. How do people use classification in their everyday lives?	• Investigate unity among organisms. *Biological change over time accounts for the diversity of species developed through gradual processes over many generations. Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.* • Investigate biological adaptations and extinction. *Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to allow its survival. Extinction of species is common; most of the species that have lived on Earth on longer exist.*	• Achaerbactria • Animalia • Class • Classification • Dichotomous key • Eubacteria • Family • Fungi • Genus • Kingdom • Order • Phylum • Plantae • Protista • Species • Taxonomy	*Students will:* • Use common objects (shoes, beans, or nuts and bolts) and classify by similar characteristics. • Use Greek and Latin roots, prefixes, and suffixes to construct scientific names (binomial nomenclature) for variations of assorted geometric shapes. • Construct a dichotomous key using leaves or twigs found locally. Then use the key to identify unknown trees. • Use a guide to common insects of North America to classify unknown insect collect by students. • Construct a floor plan for grocery store by classifying products. Compare the floor plans to an actual grocery store. Write a report explaining which plan is better the actual or students plan. • Research an organism and construct a poster showing the complete classification of that organism form Kingdom to Species.

Course/Grade 7th **Unit: Life Science:** *Survey of Kingdoms I: Viruses, Monerans and Protists* **Suggested Length:** **10 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. What is a virus? 2. How do viruses reproduce? 3. Are there any beneficial viruses? 4. What is a moneran? 5. How are monerans harmful? 6. How are monerans helpful? 7. What organisms are grouped in the Protista Kingdom? 8. How are the Protist groups compared and contrasted?	• Investigate how organisms obtain and use resources, grow, reproduce, and maintain stable internal conditions. Examine the regulation of an organism's internal environment. *All organisms must be able to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment.* ***Regulation** of an organism's internal environment involves the internal environment and changing physiological activities to keep conditions within the range required to survive. Maintaining a stable internal environment is essential for an organism's survival.* • Analyze internal or environmental stimuli and organisms' behavioral responses. Explore how organisms' behavior changes through adaptation. *Behavior is one kind of response an organism may make to an internal or environment stimulus. A behavioral response requires coordination and communication of many levels including cells, organ systems, and organisms. Behavioral response is a set of actions determined in part by heredity and in part from experience.* • Analyze regulation and behavior *Regulation of an organism's internal environment involves sensing the internal environment and changing physiological activities to keep conditions within the range required to survive. Maintaining a stable internal environment is essential for organism's survival.*	• Aerobes • AIDS • Algae • Anaerobes • Antibiotic • Cilia • Endospore • Fission • Flagellum • Nitrogen-fixing bacteria • Parasite • Pathogen • Protists • Protozoans • Pseudopods • Saprophyte • Toxin • Vaccine • Virus	*Students will:* • Examine forms of bacteria using a compound microscope with oil immersion lens and prepared slides. • Design an investigation to analyze the effect that various commercial soaps have on bacteria collected from student's hands. • Observe bacterial colonies collected from various sites through the school and grown on agar media. • Research assigned diseases and report findings to the class. Create a multimedia presentation, brochure, poster or video to inform other students of the causes, symptoms, treatment or cures for the disease. (WP-Transactive) • Collect water samples from local ponds, streams or standing pools to investigate for different forms of protozoans and algae using the compound microscope. Create a handbook of common local protists. • Create a "fictitious" protist showing structures related to all life functions. • Follow a recipe to make yogurt. Research and report on the important uses of bacteria in food production. *(Continued next page)*

	Behavior is one kind of response an organism may make to an internal or environmental stimulus. A behavior response requires coordination and communication on many levels including cells, organ systems, and organisms. Behavioral response is a set of actions determined in part by heredity and in part from experience. *Behavior responses to internal stimuli can be innate or learned. Responses to external stimuli can result from interactions with the organism's own species and/or other species, as well as environmental changes.* *The broad pattern of behavior exhibited by organisms have changed over time through natural selection to ensure reproductive success. Organisms often live in unpredictable environments, so their behavioral responses must be flexible enough to deal with uncertainty and change. Behavior often has adaptive logic.* • Analyze diversity and adaptation. *Biological change over time account for the diversity of species developed through gradual processes over many generations. Biological adaptations include changes in structures, behavior, or physiology that enhance survival and reproductive success in a particular environment.* • Contrast asexual and sexual reproduction • Analyze reproduction *Reproduction is a characteristic of all living systems and is essential to the continuation of every species. Some organisms reproduce asexually, others reproduce sexually. In species that reproduce sexually, including humans and plants, male and female sex cells carry genetic information unite to begin the development of a new individual.*		

Course/Grade 7th **Unit: Life Science:** *Survey of Kingdoms II: Fungi* **Suggested Length:** **10 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. What is a fungus? 2. How can fungi be helpful or harmful? 3. How are fungi different from other organisms?	• Investigate how organisms obtain and use resources, grow, reproduce, and maintain stable internal conditions. Examine the regulation of an organism's internal environment. *All organisms must be able to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment.* *Regulation of an organism's internal environment involves the internal environment and changing physiological activities to keep conditions within the range required to survive. Maintaining a stable internal environment is essential for an organism's survival.* • Analyze internal or environmental stimuli and organisms' behavioral responses. Explore how organisms' behavior changes through adaptation. *Behavior is one kind of response an organism may make to an internal or environment stimulus. A behavioral response requires coordination and communication of many levels including cells, organ systems, and organisms. Behavioral response is a set of actions determined in part by heredity and in part from experience.* • Analyze regulation and behavior *Regulation of an organism's internal environment involves sensing the internal environment and changing physiological activities to keep conditions within the range required to survive. Maintaining a stable internal environment is essential for organism's survival.*	• Club fungi • Decomposers • Fungus • Hyphae • Imperfect fungi • Lichen • Mold • Mycelium • Sac fungi • Sporangia • Spore	*Students will:* • Observe mushroom; identify the stalk, gills and cap. • Research a species of sac or club fungus using an encyclopedia or on the Internet. • Create lifelike clay models of the fungi and make a classroom display of the fungi models • Research the many ways fungi are used in food products. Create a cookbook of favorite fungi based recipes. Prepare some foods that contain fungi for a fungi smorgasbord (e.g. bread, bleu cheese) • Observe and photograph fungi in their natural settings. Create a display of the photos. • Create and observe a fungi garden using soil and vegetable matter as the substrate. • Investigate haw the fungi reproduce on the substrate using hand lenses or microscopes. • Design and investigation to determine the best conditions for the growth of bread mold. Use the information gathered to create a report/newspaper article to tell consumers the best way to keep their bread fresher longer. (WP-Transactive) • Research the medical and technical uses of fungi. Create a multimedia presentation of the findings *(Continued next page)*

	Behavior is one kind of response an organism may make to an internal or environmental stimulus. A behavior response requires coordination and communication on many levels including cells, organ systems, and organisms. Behavioral response is a set of actions determined in part by heredity and in part from experience. *Behavior responses to internal stimuli can be innate or learned. Responses to external stimuli can result from interactions with the organism's own species and/or other species, as well as environmental changes.* *The broad pattern of behavior exhibited by organisms have changed over time through natural selection to ensure reproductive success. Organisms often live in unpredictable environments, so their behavioral responses must be flexible enough to deal with uncertainty and change. Behavior often has adaptive logic.* • Analyze diversity and adaptation. *Biological change over time account for the diversity of species developed through gradual processes over many generations. Biological adaptations include changes in structures, behavior, or physiology that enhance survival and reproductive success in a particular environment.* • Contrast asexual and sexual reproduction • Analyze reproduction *Reproduction is a characteristic of all living systems and is essential to the continuation of every species. Some organisms reproduce asexually, others reproduce sexually. In species that reproduce sexually, including humans and plants, male and female sex cells carry genetic information unite to begin the development of a new individual.*		

Course/Grade 7th **Unit: Life Science:** *Survey of Kingdoms III: Plants* **Suggested Length:** **10 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. What are plants and how do they differ form other organisms? 2. How are plants classified? 3. How do plants obtain energy for living? 4. What would life on earth be like without plants?	• Investigate how organisms obtain and use resources, grow, reproduce, and maintain stable internal conditions. Examine the regulation of an organism's internal environment. *All organisms must be able to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment.* *Regulation of an organism's internal environment involves the internal environment and changing physiological activities to keep conditions within the range required to survive. Maintaining a stable internal environment is essential for an organism's survival.* • Analyze internal or environmental stimuli and organisms' behavioral responses. Explore how organisms' behavior changes through adaptation. *Behavior is one kind of response an organism may make to an internal or environment stimulus. A behavioral response requires coordination and communication of many levels including cells, organ systems, and organisms. Behavioral response is a set of actions determined in part by heredity and in part from experience.* • Analyze regulation and behavior *Regulation of an organism's internal environment involves sensing the internal environment and changing physiological activities to keep conditions within the range required to survive. Maintaining a stable internal environment is essential for organism's survival.*	• Angiosperm • Cellular respiration • Chlorophyll • Cotyledon • Deciduous • Dormant • Evergreen • Fruit • Gametophyte • Gravitropism • Gymnosperm • Hydrotropism • Nonvascular • Ovary • Petal • Phloem • Phototropism • Pistil • Pollen • Pollination • Rhizoid • Rhizome • Seed • Sepal • Sporophyte • Stamen • Stigma • Stomata • Transpiration • Tropism • Vascular	*Students will:* • Compare and contrast the life cycle of a plant with that of bacteria and that of fungi. Create a series of illustrations that show how all three-organism types reproduce and to include captions that explain similarities and differences. • Collect specimens of moss. Document the stage of the life cycle using a camera and microscope. Illustrate the life cycle using the real life photos. • Research the uses of sphagnum moss. Design an investigation showing the absorbent qualities of the plant. • Investigate the folklore that says that moss grows on the north side of trees. Write an article for a camping or hiking magazine. (WP-Transactive) • Research the connection between coal and seedless vascular plants. Discuss the importance of these plants remnants. • Collect seeds/fruits of indigenous plants. Examine the seeds/fruit to analyze the typical method of dispersal. Explain how these specialized dispersal mechanisms give plants competitive advantage. • Create an investigation to determine the requirements for germination of native seeds. • Dissect seeds (Lima bean and corn). Compare and contrast the structures observed and illustrate the findings with captions indicating the differences. • Using the cross-section on a large tree investigate the age of the tree using the xylem growth rings. Research and report on important historical events from the year • Research thorns and other "painful/poisonous" plant parts telling what specific plant part have been modified for this defense adaptation. (*Continued next page*)

	Behavior is one kind of response an organism may make to an internal or environmental stimulus. A behavior response requires coordination and communication on many levels including cells, organ systems, and organisms. Behavioral response is a set of actions determined in part by heredity and in part from experience. *Behavior responses to internal stimuli can be innate or learned. Responses to external stimuli can result from interactions with the organism's own species and/or other species, as well as environmental changes.* *The broad pattern of behavior exhibited by organisms have changed over time through natural selection to ensure reproductive success. Organisms often live in unpredictable environments, so their behavioral responses must be flexible enough to deal with uncertainty and change. Behavior often has adaptive logic.* • Analyze diversity and adaptation. *Biological change over time account for the diversity of species developed through gradual processes over many generations. Biological adaptations include changes in structures, behavior, or physiology that enhance survival and reproductive success in a particular environment.* • Contrast asexual and sexual reproduction • Analyze reproduction *Reproduction is a characteristic of all living systems and is essential to the continuation of every species. Some organisms reproduce asexually, others reproduce sexually. In species that reproduce sexually, including humans and plants, male and female sex cells carry genetic information unite to begin the development of a new individual.*		• Design an investigation to determine the reproductive rate/potential of duckweed as it relates to runoff of lawn fertilizers. Create a multimedia/brochure presentation for the community garden club. • Create a salad and identify each item as a monocot, divot, fruit, vegetable. List the part of the plant that is eaten. (stem, root, leaves) • Create a three-dimensional model of a flower showing both male and female parts. Develop a key for the flower model. • Research/Design/Create a garden to attract butterflies or beneficial insects. Use plants propagated from cuttings donated by local gardeners. • Design an experiment that shows tropism in plants. Create a multimedia presentation showing the results of the experiment. • Conduct and experiment to observe the process of photosynthesis and determine the rate of photosynthesis for *Elodea.*

Course/Grade 7th **Unit: Life Science:** *Survey of Kingdoms IV: Invertebrates* **Suggested Length:** **10 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. What are invertebrates? 2. What special features do an invertebrate have that help it to survive in its environment? 3. How are invertebrates classified? 4. What impact both, negative and positive do invertebrates have on the human population?	• Investigate how organisms obtain and use resources, grow, reproduce, and maintain stable internal conditions. Examine the regulation of an organism's internal environment. *All organisms must be able to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment.* *Regulation of an organism's internal environment involves the internal environment and changing physiological activities to keep conditions within the range required to survive. Maintaining a stable internal environment is essential for an organism's survival.* • Analyze internal or environmental stimuli and organisms' behavioral responses. Explore how organisms' behavior changes through adaptation. *Behavior is one kind of response an organism may make to an internal or environment stimulus. A behavioral response requires coordination and communication of many levels including cells, organ systems, and organisms. Behavioral response is a set of actions determined in part by heredity and in part from experience.* • Analyze regulation and behavior *Regulation of an organism's internal environment involves sensing the internal environment and changing physiological activities to keep conditions within the range required to survive. Maintaining a stable internal environment is essential for organism's survival.*	• Annelids • Antennae • Arachnids • Arthropods • Asymmetrical • Bilateral symmetry • Bivalves • Castings • Cephalopods • Cephalothorax • Closed circulatory system • Cnidarians • Coelom • Collar cells • Compound eye • Crustaceans • Echinoderms • Endoskeleton • Exoskeleton • Flat worms • Flukes • Ganglia • Gastropods • Host • Hydra • Insects • Invertebrate • Larvae • Mandible • Mantle • Medusa • Metamorphosis • Millipedes • Mollusks	*Students will:* • Dissect invertebrate specimens to investigate the presence and complexity of organs systems. • Construct an ecosystem (e.g. terraria, aquaria) and record information about the requirements to sustain the live of an invertebrate. Describe the interrelationship of among living and nonliving elements of the ecosystem. Develop multimedia presentations to share findings with students from other schools via Internet or e-mail. • Investigate and analyze the life cycle of the fruit fly. Document observation using a digital or conventional camera and a microscope. • Design and investigation to observe the response of a planarian to the presence of a stimuli (e.g. light, heat, food) • Have an invertebrate banquet and create culinary dishes that use invertebrates as the main source of protein. Invite members of the community to the banquet. Document the event with digital photos. Write newspaper articles describing the reaction of the guests to the banquet. (WP-Transactive) • Design and create a composting center that uses earthworms. Invite the school cafeteria to dispose of vegetable kitchen waste in the composter. Observe and analyze the change in the organic matter. • Research the type of plants that attract beneficial insects. Design and create a butterfly garden. Observe and analyze which plants are more successful at attracting butterflies. Create a brochure of the findings and distribute to local nurseries. (WP-Transactive) *(Continued next page)*

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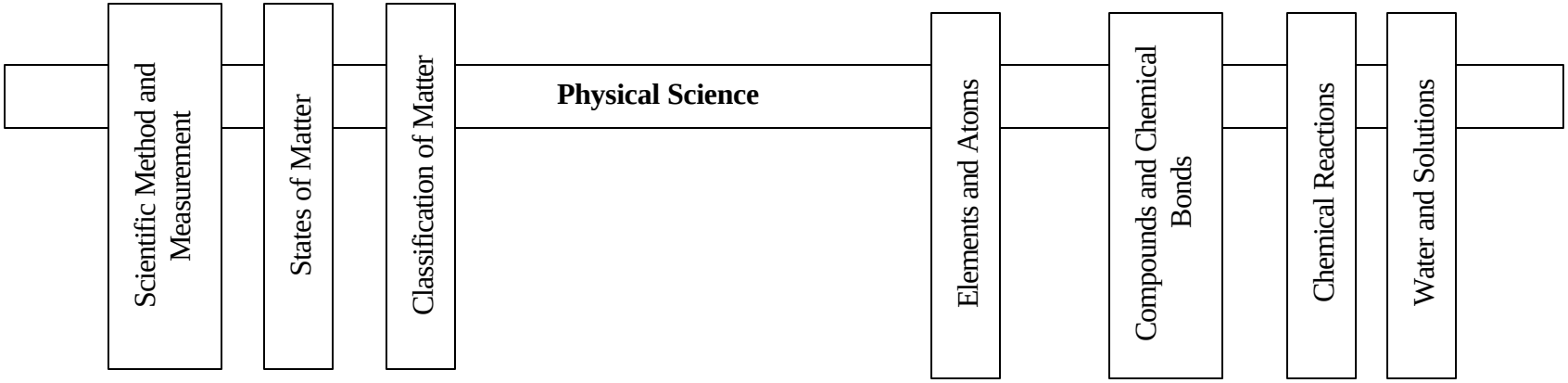
Middle School Science Curriculum
Physical Science – Grade 8

Description

In grade eight, students will focus on basic chemistry. This will allow the students to form a foundation on which to build knowledge in anticipations of high school chemistry. The understanding that the students will gain from eighth grade science will provide motivation and the basic building blocks to succeed in high school.

Units



Course Questions

A. How does chemistry impact in the world in which humans live and interact?
B. How does the knowledge of chemistry affect decisions we made about our future?

Course/Grade **8th** **Unit: Physical Science:** *Scientific Method and Measurement* **Suggested Length:** **4 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How can you solve a problem in a scientific manner? 2. How do we communicate our findings? 3. How can you stay safe while experimenting? 4. How do you measure matter? 5. Should all people use the same system of measurement? Why or why not?	• Identify and refine questions that can be answered through scientific investigations combined with scientific information. *Identify and refine questions and identify scientific concepts to guide the design of scientific investigations.* • Use appropriate equipment (e.g., barometers), tools (e.g., meter sticks), techniques (e.g., computer skills), technology (e.g., computers), and mathematics in scientific investigations. *Use evidence, logic, and scientific knowledge to develop and revise scientific explanations and models.* • Use evidence (e.g., computer models), logic, and scientific knowledge to develop • Communicate (e.g., write, graph) designs, procedures, and results of scientific investigations. *Communicate designs, procedures, and results of scientific investigations.* • Review and analyze scientific investigations and explanations of other students. • Review and analyze scientific investigations and explanations of others.	• Graphing • Mass, volume and length of matter • Problem solving • Scientific method • Systems of measurement	*Students will:* • Investigate different systems of measurement using "Who Wants to be a Ruler?" webquest, and develop a measurement board game. • Design an experiment to investigate a community issue or problem that requires hypothesizing, data collection, evaluation of data and making inferences. • Present investigation findings to peer audience and/or commu nity members which includes use of computer presentation programs (e.g., Power Point) • Use equipment to measure volume, mass, length and temperature of various objects. • Develop a creative piece which addresses laboratory safety.

Course/Grade 8th Unit: Physical Science: *States of Matter* **Suggested Length: 4 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How do the different states of matter relate to each other? 2. How is an object's internal structure related to its state of matter? 3. How does a change it temperature effect an objects internal structure and its state of matter? 4. How does density affect an objects ability to sink or float? 5. How do changes in temperature and pressure effect and object's physical properties?	• Investigate how the structure of matter (e.g., constituent atoms, distances and angles between atoms) relates to physical properties of matter. *Solids, liquids, and gases differ in the distances between molecules or atoms and therefore the energy that binds them together. In solids, the structure is nearly rigid; in liquids, molecules or atoms move around each other but do not move apart; and in gases, molecules or atoms move almost independently of each other and are relatively far apart.* • Analyze properties (e.g., boiling point, solubility) and changes of properties in matter. *The physical properties of compounds reflect the nature of the interactions among molecules. These interactions are determined by the structure of the molecule including the constituent atoms.*	• Boiling Point, Freezing Point, Condensation, Evaporation & Sublimation. • Boyle's Law • Charles's Law • Density • States of Matter • Thermal Expansion	*Students will:* • Use a density column to analyze the affects density produces on various liquids and small objects. • Produce models which illustrate the three main states of matter. • Investigate the effects of temperature on the volume of a balloon. • Use a vacuum to determine the changes associated with reduced pressure. • Expert group investigation of laws and principles associated with states of matter

Course/Grade 8th **Unit: Physical Science:** *Classification of Matter* **Suggested Length:** **3 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How are mixtures and pure substances different? 2. How do you classify pure substances? 3. How are mixtures classified? 4. How can different types of mixtures be separated into their components?	• Investigate how the structure of matter (e.g., constituent atoms, distances and angles between atoms) relates to physical properties of matter. *The physical properties of compounds reflect the nature of the interactions among molecules. These interactions are determined by the structure of the molecule including the constituent atoms.*	• Alloys • Elements, compounds and mixtures. • Physical properties of mixtures • Suspensions, colloids and solutions.	*Students will:* • Classify various store-bought substances as element, compound or mixture based on their ingredient labels. • Develop methods of separating various mixtures into their components based on their physical properties. • Analyze and model the physical characteristics of suspensions, colloids and solutions. • Categorize the different chemical and physical changes and properties. • Investigate properties of substances (e.g., color, texture, hardness etc.), analyze the properties of the substances and produce consumer information pamphlets. (WP-Transactive)

Course/Grade 8th **Unit: Physical Science:** *Elements and Atoms* **Suggested Length:** **10 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. What are the basic building blocks of matter? 2. How is the smallest basic unit of matter organized? 3. How can you tell the difference between different types of atoms? 4. How and when does a structure of an atom change? 5. How are different elements classified? 6. How do models help us to understand the atom?	• Analyze atomic structure and electric forces. *Matter is made of minute particles called atoms, and atoms are composed of even smaller components. The components of an atom have measurable properties such as mass and electrical charge. Each atom has a positively charged nucleus surrounded by negatively charged electrons. The electric force between the nucleus and the electrons holds the atom together.* *The atom's nucleus is composed of protons and neutrons that are much more massive than electrons. When an element has atoms that differ in the number of neutrons, these atoms are called different isotopes of the element.* *An element is composed of a single type of atom. When elements are listed according to the number of protons, repeating patterns of physical and chemical properties identify families of elements with similar properties. The periodic table is a consequence of the repeating pattern of outermost electrons.*	• Atomic structure • Atomic mass and atomic number. • Isotopes • Periodic Table • Metals, Nonmetals & metalloids	*Students will:* • Build models of atoms and isotopes of various elements. • Classify elements based on their chemical reactivity and increasing atomic numbers. • Recreation of the Periodic Table using increasing atomic number and characteristics. • Use a conductivity meter to sample various items to check for electrical current

Course/Grade **8th** **Unit: Physical Science:** *Compounds and Chemical Bonds* **Suggested Length: __Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. Why do atoms form chemical bonds? 2. How can you tell the difference between the different types of chemical bonds? 3. How can you determine the chemical formula of a compound? 4. How are compounds named? 5. How do you determine the mass of a compound?	• Analyze atomic structure and electric forces. *Atoms interact with each other by transferring or sharing outermost electrons. These outer electrons govern the chemical properties of the element.* • Investigate how the structure of matter (e.g., outer electrons, type of bond) relates to chemical properties of matter. *Bonds between atoms are created when outer electrons are paired by being transferred or shared. A compound is formed when two or more kinds of atoms bind together chemically.* • Investigate how the structure of matter (e.g., constituent atoms, distances and angles between atoms) relates to physical properties of matter. *The physical properties of compounds reflect the nature of the interactions among molecules. These interactions are determined by the structure of the molecule including the constituent atoms*	• Chemical formulas • Compounds • Covalent bonds • Dot diagrams • Ions and ionic bonds • Molecular mass • Naming of compounds • Polyatomic ions	*Students will:* • Illustrate the bonding process using a computer program (Hyperstudio). • Participate in a kinetic activity demonstrating valence electrons • Write in journals exhibiting knowledge of the bonding processes. • Draw ionic and covalent bonds • Will perform " atoms attack " web quest

Course/Grade 8th Unit: Physical Science: *Chemical Reactions* **Suggested Length: __Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How can you tell the difference between a chemical change and a physical change? 2. How do physical properties of compounds change when there is a chemical reaction? 3. Why do chemical changes occur? 4. How does a chemical equation represent a chemical change? 5. Why do chemical equation have to be balanced? 6. How is mass effected during a chemical reaction? 7. How do you predict the products of a chemical reaction? 8. How do you classify reactions that involve a change in energy? 9. How is a chemical reaction different from a nuclear reaction? 10. Why and how do elements undergo nuclear fusion and nuclear fission? 11. How do we use the process of nuclear decay?	• Examine nuclear structure, nuclear forces, and nuclear reactions (e.g., fission, fusion, radioactivity). *The forces that hold the nucleus together, at nuclear distances, are usually stronger than the forces that would make it fly apart.* • Investigate chemical reactions and the release or consumption of energy. *Nuclear reactions convert a fraction of the mass of interacting particles into energy, and they can release much greater amounts of energy than atomic interactions. Fission is the splitting of a large nucleus into smaller pieces. Fusion is the joining of two nuclei at extremely high temperature and pressure. Fusion is the process responsible for the energy of the Sun and other stars.* • Examine the transfer of electrons or hydrogen ions between reacting ions, molecules, or atoms. *Atoms interact with each other by transferring or sharing outermost electrons. These outer electrons govern the chemical properties of the element.*	• Balancing chemical equation • Chemical properties, • Conservation of mass • Decomposition reactions • Endothermic vs. exothermic reactions • Fission vs. fusion • Radioactive decay • Replacement reactions • Synthesis reactions	*Students will:* • Participate in a lab activity designed to explain the law of conservation of mass • Mystery box is a game that involves the entire class and helps them to sharpen their observation and inference skills • Investigate the chemical properties of various substances and gather data into a classification table • Measure the thermal energy change during several chemical reactions

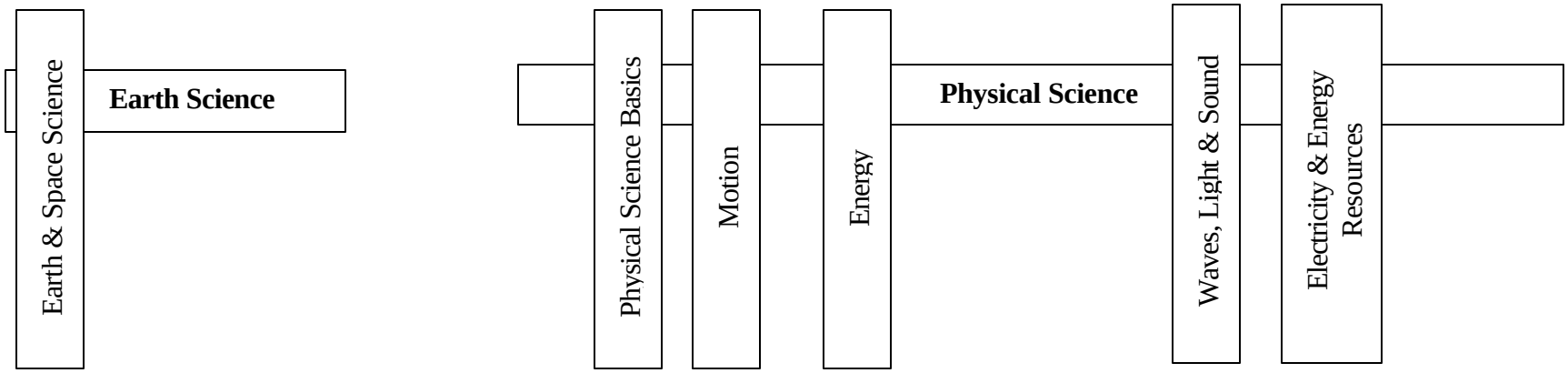
Course/Grade 8th Unit: Physical Science: *Water and Solutions* **Suggested Length: __Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. Why does water not mix with all other liquids? 2. Why do some people filter their water? 3. Why is water so important to humans? 4. Why is acid rain harmful? 5. How is acid rained formed? 6. How do you categorize acids and bases? 7. How do acids and bases react with each other?	• Investigate how the structure of matter (e.g., outer electrons, type of bond) relates to chemical properties of matter. • Investigate how the structure of matter (e.g., constituent atoms, distances and angles between atoms) relates to physical properties of matter. *The physical properties of compounds reflect the nature of the interactions among molecules. These interactions are determined by the structure of the molecule including the constituent atoms.* • Examine the transfer of electrons or hydrogen ions between reacting ions, molecules, or atoms. *Atoms interact with each other by transferring or sharing outermost electrons. These outer electrons govern the chemical properties of the element.*	• Acid Rain • Acids, Bases & Salts • Concentration • PH • Polar vs. NonPolar Molecules • Soaps & Detergents • Solubility • Solutions	*Students will:* • Examine Earth's natural filtration through different types of soils. Simulate pollutants using food coloring introduced with a water source to investigate pollution infiltration. • Investigate sources and effects of acid rain. Explore effects of acid rain on plants. Design and conduct controlled experiments to show effects of acid rain on plants. • Investigate sources of air pollution in Kentucky and actions taken to address air pollution problems within the state.

High School Science Curriculum
Physical Science – Grade 9

Description

Units



Course Questions

Course/Grade **Intro to Physics Grade 9** **Unit:** *Physical Science Basics* **Suggested Length:** **2 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How is the scientific method used to solve problems? 2. Why are different variables necessary in scientific experiments? 3. Why are standards of measurements necessary? 4. How can a graph help you observe change?	• Use equipment, tools, techniques, technology, and mathematics *Describe how science helps drive technology and technology helps drive science.* • Use evidence, logic, and scientific knowledge *Demonstrate the role science plays in everyday life.* • Communicate designs, procedures, and results.	• Experimental techniques • Law vs. theory • Problem solving techniques • Science vs. technology • Scientific method • SI system of units • Standard and derived units • Types of graphs	*Students will:* • Discuss examples if technology in their lives • Use scientific method to identify and solve problems that they observe • Manipulate variables in simple experiments and observe the varying results • Use standard measurements (length, mass) taken from geometric objects (wood cubes) to find derived measurements (density). • Create graphs given data tables • Interpret graphs • Examine a research article in a scientific journal. Identify the hypothesis, independent and dependent variables; study the data and evaluate the conclusions. • Design and carry out an experiment for the purpose of expanding existing knowledge developed through previous experimentation. • Develop measuring skills using a balance and a metric ruler. Use graphing skills to make interpretations about data, and compare the relationships among the mass, length, and number of coins in a roll. • Measure the effect of increasing forces on the length of a rubber band, graph the results of the experiment, and interpret the graph. • Portfolio: Write a letter of a feature article to convince your audience to support adoption of the SI system of units.

Course/Grade **Intro to Physics Grade 9** **Unit:** *Motion* **Suggested Length:** **6 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How can we use forces and the laws of motion to understand the motion of objects? 2. Why is inertia important to a moving object? 3. How are mass and weight different? 4. How do you know when an object is moving? 5. How does air resistance affect a falling object? 6. Why do projectiles follow a curved path? 7. How can an object move with a constant speed, but still accelerate? 8. How is momentum conserved?	• Investigate forces and the effects of forces on the motion of objects *Objects change their motion only when a net force is applied* • Investigate gravitational and electromagnetic forces *Gravity is a universal force that each mass exerts on every other mass*	• Acceleration • Air resistance • Circular motion • Conservation of momentum • Forces and net forces • Friction • Gravity • Inertia • Momentum • Newtion's first law • Newton's 2nd law • Newton's 3rd law • Projectile motion • Speed • Velocity • Weight	*Students will:* • Measure and calculate speed of a moving object • Investigate effects of forces on the motion of objects. Attach strings to carts and then attach each string to one standard mass of 100 grams. Place carts on tables and suspend standard masses over edge of tables. Use suspended masses to pull carts length of tables with photogates. Repeat multiple trials with different Measure time masses loaded on carts. Use same 100-gram standard mass suspended over table edge for each trial. Produce graphs of distance versus time for different masses loaded on cart. Analyze slope of curves and predict relationships between mass and acceleration while using a constant force. Extend activity by comparing the force used to throw baseballs and golf balls with their mass and acceleration. • Create distance vs. time and velocity vs. time graphs and interpret those types of graphs. • Investigate the importance of inertia using lab equipment. • Measure and calculate acceleration given a net force. • Predict and measure time required for an object to fall (egg drop). • Create, calculate, and construct two dimensional vectors. • Investigate circular motion with turntable. • Investigate action/reaction pairs (skateboard lab). • Predict behavior of objects after collisions (conservation of momentum). • Investigate the laws of physics most often employed in amusement park thrill rides. Using computer software, design a thrill ride. • Create models of bridges, and test the structures to identify which one functions best. *(Continued next page)*

			• Using a ramp and a small ball determine the average speed of the ball, study the forces that affect its motion, observe the deceleration of the ball, and determine conditions that will not affect the speed of the ball. • Using a ramp, a small ball, and a can: predict the flight times of a projectile, measure the speed of the projectile, analyze the flight time of a projectile, and predict the location of the projectile's landing. • Use ballistic pendulum to observe and measure the conservation of energy and momentum during an inelastic collision. • Use a TI graphing calculator, a CBL system, and a motion detector to measure distance and velocity. Use a TI graphing calculator to produce graphs of the students' motion. Analyze and interpret graphs of the student motion. (See Vernier, Physical Science with CBL, Experiment 35 Graphing Your Motion) • Use a TI graphing calculator, a CBL system, and a motion detector to measure distance and velocity. Produce distance vs. time and velocity vs. time graphs. Analyze and explain the results. (See Vernier, Physical Science with CBL, Experiment 40 Falling Objects)

Course/Grade **Intro to Physics Grade 9** **Unit:** *Energy* **Suggested Length:** **6 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How is the transfer of energy controlled by the conservation of energy and by the tendency toward disorder? 2. How are temperature scales created? 3. How is the thermal energy of a substance transferred? 4. How do machines make work easier? 5. How are compound machines constructed?	• Identify and refine questions and identify scientific concepts to guide the design of scientific investigations. • Design and conduct different kinds of scientific investigations for a wide Variety of reasons. • Use equipment (e.g., microscopes, lasers), tools (e.g., beakers), techniques (e.g., microscope skills), technology (e.g., computers), and mathematics to improve scientific investigations and communications. • Use evidence, logic, and scientific knowledge to develop and revise scientific explanations and models. • Communicate designs, procedures, and results of scientific investigations. • Review and analyze scientific investigations and explanations of others. • Examine how energy is transferred and recognize that the total energy of the universe is constant *The total energy of the universe is constant. Energy can be transformed but never destroyed.* • Distinguish between types of energy *All energy can be considered to be either kinetic energy, potential energy, or energy contained in a field.*	• Conduction • Conservation of energy • Convection • Heat • Heat engines • Heating systems • Kinetic/potential energy • Radiation Simple machines • Specific heat • Temperature • Thermal energy • Thermal pollution • Work	*Students will:* • Predict speeds or locations of moving objects using conservation of energy. • Investigate work done to raise objects. • Examine energy transfer. Explain how thermal energy is produced in toasters by tracing energy back to its source. List forms of energy during different stages of transfer. Produce brochures to be distributed by local electric cooperatives containing consumer information about efficient energy use by home appliances. (WP-Transactive) • Investigate types of energy. Use photogate timer, meter stick, and balance to collect data and calculate change in potential energy and kinetic energy during swing of simple pendulum. Develop reports for customers in local stores that sell grandfather clocks explaining the construction features of clocks that efficiently use kinetic and potential energy. Write encyclopedia entries explaining the interaction between kinetic and potential energy in grandfather clocks. (WP-Transactive) • Examine the tendency to become less organized. • Design and conduct experiments to determine the rate of dispersion of food coloring dropped into water of different temperatures. Produce reports describing the inquiry approach, observations, and explanations of effects of temperature on rates of dispersion. • Using a variety of objects, design and construct a machine which can be used to elevate a box of books from the floor to the table. • Assume the role of a United States patent office reviewer; respond to a proposal for a machine which claims to produce more energy than it consumes. Justify your decision to reject or accept the patent.

(Continued next page)

	• Examine how everything tends to become less organized and less orderly over time. *Heat is the manifestation of the random motion and vibrations of atoms, molecules, and ions.* *The universe becomes less orderly and less organized over time.*		• Use or construct a calorimeter. Measure temperature, calculate the heat transferred when hot and cold water are mixed, and calculate the heat transferred when a hot object is placed in water. • Use a calorimeter to determine the specific heat of a piece of metal, and identify the metal by its specific heat capacity. • Use a calorimeter, a TI graphing calculator, a CBL system, and a temperature probe to measure temperature and to determine the heat of fusion for ice. (See Vernier, Physical Science with CBL, Experiment 8 Heat of Fusion)

Course/Grade **Intro to Physics Grade 9** **Unit:** *Waves, Water and Sound* **Suggested Length:** **8 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. What happens when energy interacts with matter? 2. How is sound different when it travels through different media? 3. How are the several parts of the electromagnetic spectrum different? 4. How do animals see color? 5. Why is light considered a particle and a wave? 6. How are images formed with lenses and mirrors? 7. How are lenses used to correct vision?	• Design and conduct different kinds of scientific investigations for a wide variety of reasons. • Use equipment (e.g., microscopes, lasers), tools (e.g., beakers), techniques (e.g., microscope skills), technology (e.g., computers), and mathematics to improve scientific investigations and communications. • Communicate designs, procedures, and results of scientific investigations. • Review and analyze scientific Investigations and explanations of others. • Investigate energy transfer caused when waves and matter interact (e.g., atoms and molecules can absorb and emit light waves). *Waves, including sound and seismic waves, waves on water, and electromagnetic waves, can transfer energy when they interact with matter. Apparent changes in frequency can provide information about relative motion.* *Electromagnetic waves, including radio waves, microwaves, infrared radiation, visible light, ultraviolet radiation, x-rays, and gamma rays, result when a charged object is accelerated.*	• Cameras • Color • Concave lenses • Concave mirrors • Convex lenses • Convex mirrors • Diffraction • Doppler effect • Electromagnetic spectrum • Interference • Microscopes • Music • Plane mirrors • Polarized light • Reflection • Refraction • Telescopes • Total internal reflection • Types of waves • Visible light • Vision • Wave frequency • Wave intensity • Wave interference • Wave velocity	*Students will:* • Identify types of waves. • Create different types of waves. • Calculate the frequency or wavelength of light. • Observe the doppler effect. • Investigate musical sounds (guitar and strobe light). • Observe wave interference. • Investigate uses of wave interference (sweep sonar). • Identify parts of the electromagnetic spectrum. • Identify parts of the visible spectrum. • Investigate what is seen by the eye when different colored light is mixed. (light box). • Calculate angle of reflection when given the angle of incidence of light. • Investigate the bending of light in different media. • Calculate the angle of refraction when given the medium and the angle of incidence. • Identify virtual and real images. • Predict the characteristics of an image given all of the pertinent information. • Investigate how the eye works. • Observe the polarization of light (using polarizing film). • Investigate fiber optic use. • Identify the crest, trough, and amplitude of a wave, determine the wavelength and frequency of a wave, and calculate the velocity of a wave. • Demonstrate that sound is produced by vibrations of matter, vary the pitch of vibrating objects, and explain the relationship between pitch and frequency of sound. • Using a prism and diffraction grating, make and describe two spectra. *(Continued next page)*

			• Observe that light travels in straight lines, identify the angles of incidence and reflection of reflected light, describe the relationship between the angle of incidence and the angle of reflection. • Create a system which employs various convex and concave mirrors to increase the intensity of a beam of light. Investigate practical applications of the system. Design a tool or device, using the procedure. • Use a TI graphing calculator, a CBL system, and a light sensor to measure the intensity of transmitted light, record data, make a graph of the data, and study the transmission of light by Polaroid filters. (See Vernier, Physical Science with CBL, Experiment 24 Polaroid Filters). • WP: Write a brochure on the use of lenses for correcting vision. • WP: Write a brochure on the use of fiber optics in the communication industry.

Course/Grade **Intro to Physics Grade 9** **Unit:** *Electricity and Energy Sources* **Suggested Length:** **8 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How is static electricity formed? 2. Why is a battery a source of electricity? 3. How are series and parallel circuits different? 4. How is electrical energy measured? 5. How can an electrical current produce a magnetic field? 6. How can a generator produce an electric current? 7. Why is energy conservation necessary? 8. How does a nuclear reactor work? 9. How can electricity be generated with alternative energy sources?	• Identify and refine questions and identify scientific concepts to guide the design of scientific investigations. • Design and conduct different kinds of scientific investigations for a wide variety of reasons. • Use equipment (e.g., microscopes, lasers), tools (e.g., beakers), techniques (e.g., microscope skills), technology (e.g., computers), and mathematics to improve scientific investigations and communications. • Use evidence, logic, and scientific knowledge to develop and revise scientific explanations and models. • Communicate designs, procedures, and results of scientific investigations. • Review and analyze scientific investigations and explanations of others. • Investigate gravitational and electromagnetic forces. *The electric force is a universal force that exists between any two charged objects. Opposite charges attract while like charges repel.* • *Investigate electrical energy and conductivity through matter.* *In conducting materials, electrons flow easily; whereas, in insulating materials, they can hardly flow at all. Semiconducting materials have intermediate behavior. At low temperatures, some materials become superconductors and offer no resistance to the flow of electrons.*	• AC/DC currents • Alternative energy sources • Batteries • Conductors • Current • Electric motors • Electrical energy • Electrical Power • Energy conservation • Fossil fuels • Generators • Insulators • Lightning • Magnetic fields • Magnets • Nuclear reactors • Ohm's Law • Potential difference • Resistance • Series and parallel circuits • Static electricity	• *Students will:* • Investigate electrical energy and conductivity through resistors. Construct series and parallel circuits with resistors. Measure voltage across each resistor and total circuit resistance. Calculate resistance from voltage drop and value of current. Draw schematic diagrams of circuits. Research electrical safety related to overloading circuits. Create consumer information brochures on electrical safety for Distribution in areas with houses older than thirty years. • Investigate electromagnetic forces. Produce electricity by thrusting one end of strong bar magnet through wire coils that have different numbers of turns. Measure electricity produced. Produce lab reports identifying variables that affect amount of electricity created. Compare this production of electricity to the electricity produced when you speak into a dynamic microphone (the diaphragm thrusts a coil through a magnetic field and produces bursts of electricity in response to sounds). Produce consumer information pamphlets for local retail stores explaining the operation of microphones and speakers and the proper way to install them. Use this activity to develop possible writing portfolio entries. (WP-Transactive) • Investigate the interaction of electrical energy and matter. Design and conduct experiments to identify variables that affect the amount of conductivity and resistance in metal wires. Produce articles that explain how these variables impact wiring for new speakers. (WP-Transactive) • Complete an electrical circuit, identify its components, and describe evidence of their interactions. • Observe magnetic fields. *(Continued next page)*

	• *Electricity and magnetism are two aspects of a single electromagnetic force. Moving electric charges produce magnetic forces, and moving magnets produce electric forces. This idea underlies the operation of electric motors and generators.*		• Investigate alternative sources of energy. • Construct electromagnets, compare the strength of the magnetic force of the electromagnets, state the relationship between the strength of the magnetic force and the number of turns of wire in the coil of the electromagnet. • Build a lead storage cell. Use a direct current power supply to charge the cell. Use a CBL system and TI voltage probe to measure the cell's voltage before and after use. Use the cell to power an electric motor, and make conclusions using the results of the experiment. (See Vemier, Physical Science with CBL, Experiment 34 Lead Storage Batteries)

Course/Grade **Intro to Physics Grade 9** **Unit:** *Earth and Space Science* **Suggested Length:** **6 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. Why do the earth's plates move? 2. How are the winds of the earth formed? 3. How are ocean currents formed? 4. How are the 2 types of waves different? 5. How are mountains formed?	• Use evidence, logic, and scientific knowledge to develop and revise scientific explanations and models. • Communicate designs, procedures, and results of scientific investigations. • Review and analyze scientific investigations and explanations of others. • Examine internal and external sources of energy. • Earth systems have sources of energy that are internal and external to the Earth. The Sun is the major external source of energy. Two primary sources of internal energy are the decay of radioactive isotopes and the gravitational energy from Earth's original formation. • Examine how internal sources of energy propel crustal plates across the face of the globe. *The outward transfer of Earth's internal heat drives convection circulation in the mantle. This causes the crustal plates to move on the face of the Earth.* *Interactions among the solid Earth, the oceans, the atmosphere, and living things have resulted in the ongoing development of a changing Earth system. Earthquakes and volcanic eruptions can be observed on a human time scale, but many processes, such as mountain building and plate movements, take place over hundreds of millions of years.* • Examine how external sources of energy produce winds and ocean currents. *Heating of Earth's surface and atmosphere by the Sun drives convection within the atmosphere and oceans, producing winds and ocean currents.* • Examine how external sources of energy determine global climate. *Global climate is determined by energy transfer from the Sun at and near Earth's surface. This energy transfer is influenced by dynamic processes such as cloud cover and the Earth's rotation and static conditions such as the position of mountain ranges and oceans.*	• Earth's plates • Plate boundaries • Convection currents • Coriollis Effect • Density differences • Tradewinds • Prevailing westerlies • Polar easterlies • P-waves • S-waves • Types of mountains • Evolution of mountains	*Students will:* • model the convection circulation in the mantle. Investigate how these convection currents propel crustal plates. Float small flat sections of styrofoam on the surface of water in a large beaker that is being heated by a hot plate. Compare the motion and causes of motion of the styrofoam to that of tectonic plates. Create investigative reports on movement of crustal plates and the New Madrid fault system. Share reports with local insurance companies for distribution to homeowners that buy earthquake insurance. (WP-Transactive) • Model convection in the atmosphere and ocean. Place a large beaker of water on a hot plate and drop food coloring into the water. Explain how this models wind and ocean currents. Create maps of global wind patterns and ocean current patterns. • Determine the location of the epicenter of an earthquake by monitoring the P and S wave patterns using a simulation. • Model a convection current in liquid and identify convection currents in air. • Use modeling clay to create a model of the earth's crust. Use the model to determine what happens to the crust when under tension or compression. Identify folds, faults, anticlines, and synclines. • Use a TI graphing calculator, a CBL system, and a pressure sensor to measure pressure. (See Vernier, Physical Science with CBL, Experiment 32 Fun with Pressure)

High School Curriculum for Life Sciences
Grade 10

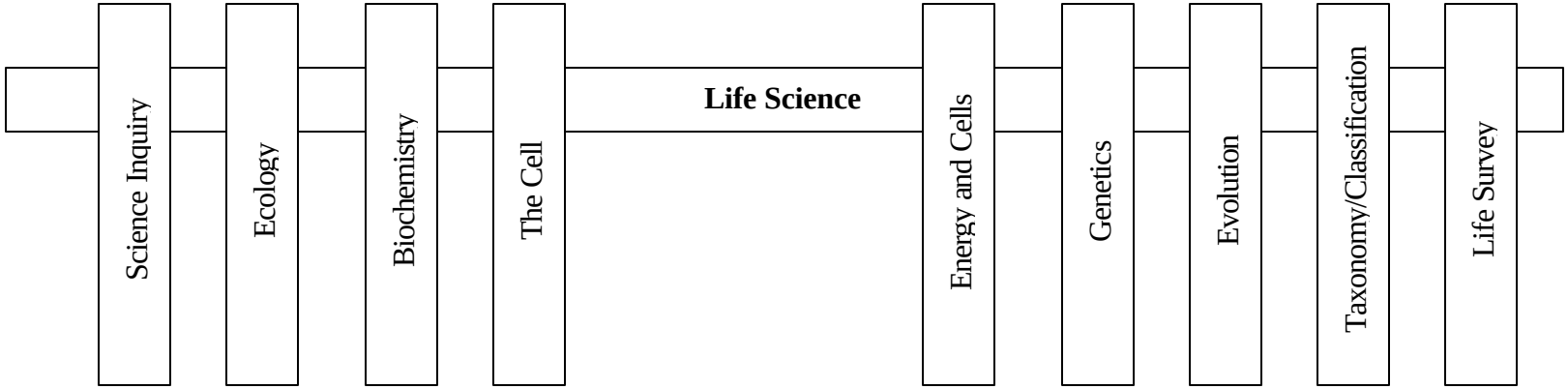
Course Descriptions

Integrated Science II
The primary focus of this course is the study of living organisms. It is offered to those students who are not scientifically oriented. Course work will center on the scientific method of discovery and laboratory experiences including the use of the microscope and various dissections. Units of study will include introductions to evolution, genetics, microbiology, botany, zoology, ecology, and current news topics related to science.

Biology I
Biology I is an introductory course designed to provide students with a fundamental understanding of important biological concepts, strengthen critical thinking skills and relate various scientific issues to their everyday lives and to society as a whole. Topics covered will include the structure and function of the cell, genetics, molecular biology, zoology, botany, evolution, ecology, and a systematic survey of the taxonomy and natural history of the major groups of living organisms. Classroom instruction will include lab investigation, individual projects, etc.

Advanced Biology I
The advanced class in biology provides in-depth studies, laboratory investigations and individual projects for students who have a deeper interest in biology. The concepts presented are centered around the modern cell processes essential to life. Major topics of study include cytology, genetics, microbiology, botany, invertebrate/vertebrate zoology, and ecology. Independent study in the various fields of biology will provide the student with a knowledge of the basic life processes and make the student more aware of the role science plays in their own lives.

Units



Course Questions

A. How do science practitioners solve problems that are important to society?
B. How do the results of previous experiments help students in their understanding and exploration of the natural world?
C. What distinguishes science from non-science?
D. How do scientists utilize and communicate their knowledge?

The following Program of Studies standards are taught in all units:

PS--Apply scientific inquiry and conceptual understandings to solving problems of technological design (e.g., styrofoam cups, transistors, computer chips).
CC--
1. Formulate testable hypothesis and demonstrate the logical connections between the scientific concepts guiding a hypothesis and the design of an experiment.
2. Use evidence, logic, and scientific knowledge to develop and revise scientific explanations and models.
3. Design and conduct different kinds of scientific investigations.

PS--Examine the interaction between science and technology.
CC--
1. Apply scientific theory and conceptual understandings to solve problems of technological design and examine the interaction between science and technology.
2. Use equipment, tools, techniques, technology, and mathematics to improve scientific investigations and communications.

PS--Explore the impact of scientific knowledge and discoveries on personal and community health.
CC--
1. Explore the impact of scientific knowledge and discoveries on personal and community health; recognize how science influences human population growth, use science to analyze the use of natural resources by an increasing human population; investigate how science can be used to solve environmental quality problems, use science to investigate natural and human-induced hazards; and analyze how science and technology are necessary but not sufficient for solving local, national, and global issues.

PS--Recognize how science influences human population growth.
PS--Use science to analyze the use of natural resources by an increasing human population.
PS--investigate how science can be used to solve environmental quality problems (e.g., over consumption, food distribution).
PS--Use science to investigate natural hazards and human-induced hazards.
PS--Analyze how science and technology are necessary but not sufficient for solving local, national, and global issues.
PS--Analyze the role science plays in everyday life and compare different careers in science.
CC--
1. Analyze the role science plays in everyday life and compare different careers in science; recognize that scientific knowledge comes from empirical standards, logical arguments, and skepticism, and is subject to change as new evidence becomes available; and investigate advances in science and technology that have important and long-lasting effects on science and society.

PS--Recognize that scientific knowledge comes from empirical standards, logical arguments, skepticism, and is subject to change as new evidence becomes available.
CC--
1. Communicate and defend the designs, procedures, observations, and results of scientific investigations.
2. Review and analyze scientific investigations and explanations of other investigators, including peers.

PS--Investigate advances in science and technology that have important and long-lasting effects on science and society (e.g., Newtonian mechanics, plate tectonics, germ theory, medical and health technology).

Course/Grade **Biology Grade 10** **Unit:** *Science Inquiry* **Suggested Length:** **2 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How is science different from other areas of study, e.g., philosophy, religion, art, when seeking answers to questions? 2. How is the practice of science and effective problem solving method?	• Identify and refine questions and identify scientific concepts to guide the design of scientific investigations. *Review and analyze scientific investigations and explanations of other investigators, including peers.* *Formulate testable hypotheses and demonstrate the logical connections between the scientific concepts guiding a hypothesis and the design of an experiment.* • Design and conduct different kinds of scientific investigations for a wide variety of reasons. *Design and conduct different kinds of scientific investigations.* • Use evidence, logic, and scientific knowledge to develop and revise scientific explanations and models. *Communicate and defend the designs, procedures, observations, and results of scientific investigations.* *Use evidence, logic, and scientific knowledge to develop and revise scientific explanations and models.* • Use equipment (e.g., microscopes, lasers), tools (e.g., beakers), techniques (e.g., microscope skills), technology (e.g., computers), and mathematics to improve scientific investigations and communications. *Use equipment, tools, techniques, technology, and mathematics to improve scientific investigations and communications.*	• Analyzing • Blind/Double blind study • Centrifuge • Chromatography • Control Conversions • Dependent variable • Direct Relationship • Electrophoresis • Hypothesis • Independent variable • Indirect relationship • Inferring • Law • Light Microscope • Metrics • Modeling • Observing • Predicting • Reliability • Researcher bias • Theory • Transmission/Scanning electron microscope	*Students will:* • Students will be given specific problems that require them to design an experiment and test hypothesis to solve problems. Lab equipment will be used appropriately and the concepts of dependant and independent variables must be employed: proper mathematics will be used as necessary. • Microscopy and Measurement--students will be given background information on history, care, types, and proper use of microscopes. Measure the thickness of a hair, thread, etc., using metrics and the microscope (see www.accessexcellence.org). • Think Tube--activity that highlights the role scientific method plays in everyday problem solving and is designed to use the students' critical thinking skills to solve a group problem (see "Think Tube" activity). • Experimental Design--investigate pulse rates/blood pressure of students where they design an experiment using the pulse/pressure as a dependent variable that measures a factor of interest. Communicate results and analysis to class. Note: CBL probe can be used to generate graphic representations of results.

Course/Grade **Biology Grade 10** **Unit:** *Ecology* **Suggested Length:** **4 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. What is ecology? How is it important to the study of Biology? 2. In what ways do organisms interact with each other? 3. How are organisms dependent on non-living factors in the environment? 4. What are the some world's major environments, and their characteristic communities? 5. How do organisms, including humans, affect/change their environment?	• Investigate the cycle of atoms (e.g., carbon) and molecules (e.g., nitrogen, carbon dioxide, oxygen) within the biosphere. *Atoms (e.g., carbon, nitrogen) and molecules (e.g., water) cycle among the living and nonliving components of the biosphere.* • Analyze energy flow through ecosystems. *Energy flows through ecosystems in one direction from photosynthetic organisms to herbivores to carnivores and decomposers.* *As matter and energy flow through different organizational levels (e.g., cells, organs, organisms, communities) and between living systems and the physical environment, chemical elements are recombined in different ways. Each recombination results in storage and dissipation of energy into the environment as heat. Matter and energy are conserved in each change* • Examine interrelationships and interdependencies of organisms in ecosystems and the factors that influence the interactions between organisms. *Human beings live within the world's ecosystems. Human activities can deliberately or inadvertently alter the dynamics in ecosystems. These activities can threaten current and future global stability and, if not addressed, ecosystems can be irreversibly affected.*	• Autotrophs • Biomes and factors that determine • Biotic/abiotic factors • Carbon, Nitrogen cycles • Carnivores Carrying capacity • Climax community • Communities • Competition • Consumers • Decomposers • Density dependent/ independent factors • Energy pyramids • Exponential growth • Food Chains • Habitat • Herbivores • Heterotrophs • Host/Parasites • Limiting factors • Niche • Nitrification • Nitrogen fixation • Omnivores • Oxygen cycle • Pioneer species • Populations • Predator/Prey	*Students will:* • Design food chains showing humans' position as primary and secondary consumers. Use food chains to construct food webs. Analyze humans' position in energy transfer. Compare vegetarian and non-vegetarian diets to determine effects of each on the environment. Use this information to argue that we should or should not become vegetarians. (WP-Transactive) • Examine how humans alter ecosystems. Explore effects of fertilizer run-off on water resources. Compare observations (e.g., nitrate level, phosphate level, level of dissolved oxygen) of water sources that are near agricultural land to sources that are not and prepare investigative reports. Participate in Kentucky's Water Watch Program. • Analyze energy flow through ecosystems. Read feature articles from fishing, hunting, or nature magazines to create food webs. Display food webs on bulletin boards. Examine diagrams of energy pyramids for typical ecosystems. Develop diagrams and memos to be used by wildlife biologists for workshops explaining why energy pyramids are broad at bottom and narrow at top. • Investigate impacts of introduced species (e.g., lamprey eel, rainbow trout, pheasant, purple loosestrife, water hyacinth, Japanese beetle, zebra mussel) on native species. Identify both benefits and liabilities of introduced species. Research ways introductions occur and develop plans to prevent them. Share plans with environmental clubs.

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	Behavioral responses to internal changes and external stimuli can be innate or learned. Responses to external stimuli can result from interactions with the organism's own species and/or other species, as well as environmental changes. *Organisms both cooperate and compete in ecosystems. Often changes in one component of an ecosystem will have effects on the entire system that are difficult to predict. The interrelationships and interdependencies of these organisms may generate ecosystems that are stable for hundreds or thousands of years.* *Living organisms have the capacity to produce populations of infinite size. However, behaviors, environments, and resources influence the size of populations. Models (e.g., mathematical, physical, conceptual) can be used to make predictions about changes in the size or rate of growth of a population.* • Examine how external sources of energy determine global climate. • Analyze Earth's chemical reservoirs and recognize that each element can exist in several reservoirs (e.g., carbon in carbon dioxide reservoirs and carbonate reservoirs). • Investigate how Earth's internal and external sources of energy drive geochemical cycles (e.g., carbon moving from carbon dioxide reservoirs to carbonate reservoirs).	• Producers • Productivity • Succession • Symbiosis • Trophic level • Water cycle	• Investigate the nitrogen cycle. Examine nodules staining with methylene blue. Sketch nitrogen-fixing bacteria. Produce brochures to be distributed to farmers by agricultural field agents about importance of bacteria. (WP-Transactive) • Predator/Prey Relationships—owl pellet investigation designed to highlight predator/prey interactions in an ecosystem (see Modern Biology, lab #51). • Abiotic Factors and Dendrochronology--tree ring study designed to determine how abiotic factors influence tree growth. • Ecosystem in a Jar—investigation designed to study species interactions, e.g., food chains that may occur in a closed ecosystem (see Modern Biology, lab #50). • Abiotic Factors and Environmental Survey—local environmental study designed to test the effects of specific abiotic factor, e.g., temp., pH, dissolved O_2, etc. on species diversity. • Population Sampling—activity designed to highlight consumer/producer relationships, energy pyramids, biotic/abiotic factors, and their influence on species diversity (see Modern Biology, lab #52). • Symbiotic Relationships—investigation designed to study the effect of mutualistic symbiotic mycorrhizae on the growth rate of host plants.

Course/Grade **Biology Grade10** **Unit:** *Biochemistry* **Suggested Length:** **3 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How is an understanding of basic chemistry essential for studying cells/organisms? 2. What is the distinction between organic and inorganic compounds and how are representatives from each group important to cells/organisms? 3. How are molecular shapes/arrangements important to the structure and function of living cells? 4. How do cell structures, functions, and processes affect living things?	• Investigate cell structures, their functions (e.g., chemical reactions), and how DNA guides their functions. *Most cell functions involve chemical reactions. Food molecules taken into cells react to provide the chemical constituents needed to synthesize other molecules. Both breakdown and synthesis are made possible by a large set of protein catalysts, called enzymes. The breakdown of some of the food molecules enables the cell to store energy in specific chemicals that are used to carry out the many functions of the cell.* *Multicellular animals have nervous systems that generate behavior. Nerve cells communicate with each other by secreting specific molecules. Specialized cells in sense organs detect light, sound, and specific chemicals enabling animals to monitor what is going on in the world around them.* *:*	• Amino acids • Atoms • Bonding • Carbohydrates • Chemical change • Chemical equations/reactions • Chemical formula • Colloids • Compounds • Condensation reaction • Covalent • DNA/RNA • Electrons • Elements • Endo/exothermic reactions • Enzymes • Families • Hydrophilic/Hydrophobic • Inorganic compound • Ionic • Ions • Isomer • Isotopes • Kinetic energy • Lipids • Mixtures • Molecules • Monomer • Neutrons • Nucleic acids • Nucleus • Orbitals	*Students will:* • Construct models of molecules to demonstrate correct bonding configurations. Analyze molecular weights, write molecular formulas, and investigate properties and classifications of each model constructed. • Investigate mixtures by physically separating the components and explain type of mixture found, e.g., solution, colloid, suspension, etc. • Identify substances such as simple carbohydrates, starches, proteins, and lipids using simple lab tests. • Run a catalase and hydrogen peroxide investigation to determine reaction rates based on different variables, e.g., substrate concentration, temperature, pH, and enzyme concentration. Explain results. • Enzymes and Digestion—investigation designed to highlight the role of the amylase enzyme on the breakdown of starches to sugars. • Enzyme Structure and Function—experiment that illustrates the effect of a denaturing factor, e.g., pH, temperature, on enzyme activity. • Macronutrients and Diet—investigation of the roles of carbohydrates, proteins, and lipids on human diet; may potentially include cross-cultural comparisons. (WP-Transactive)

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		• Organic compound • Periodic chart • Periods • pH—Acids/Bases • Physical change • Polar • Polymer • Potential energy • Proteins • Protons • Radioisotopes • Solutes • Solutions • Solvents • Structural formula • Subatomic • Suspensions	

Course/Grade **Biology Grade10** **Unit:** *The Cell* **Suggested Length:** **4 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. What is the cell theory and how did the invention of the microscope affect/influence what we know about cells? 2. What are the basic differences or similarities between plant and animal cells? 3. Why is cell specialization important to multi-cellular organisms?	• Investigate cell structures, their functions (e.g., chemical reactions), and how DNA guides their functions. *Cells have particular structures that underlie their function. Every cell is surrounded by a membrane that separates it from the outside world. Inside the cell is a concentrated mixture of thousands of different molecules that form a variety of specialized structures. These structures carry out specific cell functions.* • Investigate cell regulation, differentiation, and how the process of photosynthesis provides a vital connection between the Sun and energy needs of living systems. *Plant cells contain chloroplasts, the site of photosynthesis. Plants and many microorganisms (e.g., Euglena) use solar energy to combine molecules of carbon dioxide and water into complex, energy-rich organic compounds and release oxygen to the environment. This process of photosynthesis provides a vital link between the Sun and energy needs of living systems.* *In the development of multicellular organisms, cells multiply and differentiate to form many specialized cells, tissues, and organs. This differentiation is regulated through the expression of different genes.*	• Active transport • Anton van Leeuwenhoek • Cell theory • Cell wall • Chloroplasts • Chromoplasts • Chromosomes • Cilia • Concentration gradient • Cytolysis • Cytoplasm • Diffusion • Endocytosis • Endoplasmic reticulum • Equilibrium • Eukaryotic • Exocytosis • Facilitated diffusion • Flagellum • Fluid mozaic model • Gated channels • Golgi apparatus • Homeostasis • Hypertonic • Hypotonic • Isotonic • Leukoplasts • Lysosomes • Membranes • Microfiliments • Microtubles • Mitochondria • Multicellular • Nucleolus • Nucleus • Organ systems	*Students will:* • Investigate the evolution of eukaryotic cells. Trace the origin of cell organelles. Use graphic organizers to compare characteristics of oldest known cells to modern cells. Create illustrated time lines documenting milestones in the development of the cell theory. • Examine cell structures with light microscope. Produce photo essay or essay with student created drawings of basic cell structure (e.g., cell wall, cell membrane, nucleus, cytoplasm, chloroplast, vacuoles). Describe functions of cell structures on mechanical rather than biochemical level (e.g., nucleus and control of cell function, chloroplast and photosynthesis, mitochondria and respiration, cell membrane and transport). Include ways to test the assertion that chicken eggs are cells by comparing functions of different structures in eggs and in cells. • Observe, sketch, and compare elodea leaf cells, onion cells, and human cheek cells. Identify structural anatomy and function of organelles. • Investigate diffusion/osmosis by using dialysis tubing filled with a starch suspension, a glucose solution in various solutions, e.g., hypo/hypertonic, and measure changes and explain. • Investigate life cycles of cells. Examine videos, slides, or photographs of various stages of mitosis and interphase. Recreate stages using students to represent chromosomes. • Cell Cycle and Technology–power point presentation of cell cycle utilizing microvideography. • Osmosis Lab—laboratory designed to investigate tonicity on a semipermeable membrane and its contents. *(Continued next page)*

		• Organelles • Organs • Osmosis • Passive transport • Phagocytosis • Plasmolysis • Plastids • Prokaryotic • Ribosomes • Robert Hooke • Semipermeable • Sodium-potassium pump • Surface area/Volume principle • Tissues • Turgor pressure • Unicellular • Vacuoles	• Surface Area and Volume—investigation designed to highlight cell size and surface area to volume relationship. • Cell Structure and Function—poster and/or model construction of cell revealing representative structures and their functions. • Science and Society—write a letter to a person of influence, e.g., senator, president, corporate head, etc., espousing the pros or cons of scientific research and use of stem cells. (WP-Transactive) • Bubbleology—use of bubble material (soap, liquid bubbles, etc.) to create models of cells and demonstrate phagocytosis, pinocytosis, permeability, and the flexibility of cellular membranes.

Course/Grade **Biology Grade 10** **Unit:** *Energy and Cells* **Suggested Length:** **7 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. Where does the life-giving energy for cells originate, and how is that energy stored and released in cells? 2. How is energy transferred at a molecular level within the cell, and how do the structures that handle these molecules fit their functions? 3. What roles do membranes play in the energy harvesting of cells? 4. How is photosynthesis and respiration complimentary? 5. How is it that photosynthetic organisms are able to trap energy and convert it into a form useful for cell activities? 6. How are fermentation and cellular respiration similar/different?	• Recognize that living systems require continuous input of energy. *The chemical bonds of food molecules contain energy. Energy is released when the bonds of food molecules are broken and new compounds with lower energy bonds are formed. Cells usually store this energy temporarily in the phosphate bonds of ATP. During the process of cellular respiration, some energy is lost as heat.* • Investigate photosynthesis, cellular respiration, and the energy relationships among them. • Analyze the flow of matter and energy through and between living systems and environments. *Living systems require a continuous input of energy to maintain their chemical and physical organization since the universal tendency is toward more disorganized states. The energy for life primarily derives from the Sun. Plants capture energy by absorbing light and using it to form strong (covalent) chemical bonds between the atoms of carbon-containing molecules.* *These molecules can be used to assemble larger molecules (e.g., DNA, proteins, sugars, fats). In addition, the energy stored in the bonds between the atoms can be used as sources of energy for life processes.*	• Aerobic • Anaerobic • ATP/ADP • Calvin cycle • Carbon fixation • Chemiosmosis • Chlorophyll • Dark reactions • DE/phosphorylation • Electron carriers • Electron transport chain • Energy intermediates • Entropy • Fermentation • Glucose • Glycolysis • Grana • Krebs cycle • Lactate • Light reactions • NADP/NADPH • Oxidation • PGA • PGAL • Photosynthesis • Photosystem • Pyruvate • Reduction • Stroma • Thylakoids	*Students will:* • Investigate energy relationships between photosynthesis and respiration. Use models to illustrate the chemistry of photosynthesis and cellular respiration. Write children's stories about the life of plants describing when and where photosynthesis and respiration take place. (WP-Transactive) • Conduct fermentation lab to determine rates of fermentation using yeast and glucose solution. Use water displacement to capture CO_2. Students may alter variables such as temperature, glucose concentration, etc. • Small group huddles and performs play in front of class that demonstrates steps of cellular respiration, e.g., Kreb's cycle. Each player should explain his/her role in the play. • Create simple calorimeter to measure the relative amount of energy released by a piece of burning food, e.g., peanut. Calculate calories released and discuss process of oxidation in terms of energy requirements of cells. • Abiotic Factors and Photosynthesis —lab investigation designed to investigate the relative effects of light wavelength, temperature, CO_2, etc. on the rate of photosynthesis (see Biology—The Dynamics of Life, Biolab #10). • Plants and Energy—using geranium or *Coleus* sp., conduct an experiment that tests for production of starch in green leaves (see Modern Biology, Investigation 24.1). • Aquatic Plants and Photosynthesis/Respiration—measure production and identify gas using water displacement and glowing splint test. Measure relative production of CO_2 using bromthymol blue indicator plants left in dark vs. light (see Modern Biology, Investigation 24.2). Note: CBLs and dissolved O_2 probes may be used to measure gas production.

Course/Grade **Biology**
Grade 10

Unit: *Genetics*

Suggested Length: **7 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How are inherited traits passed on from parent to offspring? 2. How do the general principles of genetics apply to humans? 3. What are some potential problems associated with genetic engineering? 4. How are the expression and activity of genes controlled?	• Investigate how DNA carries instructions for specifying characteristics of organisms. *In all organisms and viruses, the instructions for specifying the characteristics are carried in nucleic acids. The chemical and structural properties of nucleic acids determine how the genetic information that underlies heredity is both encoded in genes and replicated.* *Multicellular organisms, including humans, form from cells that contain two copies of each chromosome. This explains many features of heredity. Transmission of genetic information through sexual reproduction to offspring occurs when male and female gametes that contain only one representative from each chromosome pair unite.* *Changes in DNA (mutations) occur spontaneously at low rates. Some of these changes make no difference to the organism, whereas others can change cells and organisms. Only mutations in germ cells have the potential to create the variation that changes an organism's future offspring.* • Investigate encoding and replication of genetic information. *Cells store and use information to guide their functions. The genetic information stored in DNA directs the synthesis of the thousands of proteins that each cell requires.*	• Adenine • Alleles • Anaphase • Anticodons • Autosomes • Blood types • Carrier • Cell plate • Centrioles • Centromere • Chromatin • Chromosome mapping • Cleavage furrow • Cloning • Codominance • Codons • Crossing over • Cytokinesis • Cytosine • Deoxyribose • Dihybrid cross • Diploid • DNA/RNA polymerase • Dominance and Recessiveness • Double helix • Equator • F_1/F_2 • Gametes • Gene expression • Genes • Genetic disorders • Genetic engineering • Genotype	*Students will:* • Examine DNA structure. Construct models of DNA molecules and show locations of genes. Display models in science labs. Write articles for the local school newspaper concerning future applications of Human Genome Project(WP-Transactive). • Investigate protein synthesis including transcription and translation. Create models to demonstrate process. Identify types of RNA present, their function, and locations. Use graphic organizers to compare protein sythesis in eukaryotes and prokaryotes. Explore evolutionary significance of common genetic language. • Investigate several karyotypes to identity specific genetic disorders. Research and report to class the phenotypic results of this disorder. • Investigate how mutations in DNA affect protein synthesis. Identify mutagens (e.g., ultraviolet lights, ionizing radiation). Write articles explaining how mutations may be harmful, neutral, or beneficial, depending on how the proteins they specify interact with other genes and the environment. (WP-Transactive) • DNA Extraction—exercise designed to highlight the presence of DNA through its extraction from raw wheat germ. (see http://gslc.genetics.utah.edu/basic/wheatgerm) • Transformation Lab—microbiological investigation that allows students to transform bacterial strains by transferring DNA from antibiotic resistant bacteria into antibiotic susceptible strains. *(Continued next page*

	Cell functions are regulated. Regulation occurs both through changes in the activity of the functions performed by proteins and through selective expression of individual genes. This regulation allows cells to respond to their internal and external environments and to control and coordinate cell growth and division.	• Germ mutations • Gregor Mendel • Guanine • Haploid • Heredity • Heterozygous • Histones • Homologous chromosomes • Homozygous • Hybrid • Hydrogen bonds • Incomplete dominance • Interphase • Karyotype • Law of Independent Assortment • Law of Segregation • Linkage groups • Meiosis • Metaphase • Mitosis • Monohybrid • Monosomy • mRNA • Multiple alleles • Mutagens • Nitrogenous bases • Non-disjunction • Nucleotides • P_1 • Pedigree • Peptide bonds • Phenotype • Polygenic traits • Polyploidy • Population sampling • Probability • Prophase • Punnett square	*(Continued next page)*

		• Purines • Pyrimidines • Replication • Restriction enzymes • Ribose • rRNA • Sex chromosome • Sex-influenced traits • Somatic mutation • Spindle • Telophase • Test cross • Thymine • Transcription • Translation • Trisomy • tRNA • Uracil	

Course/Grade **Biology Grade10** **Unit:** *Evolution* **Suggested Length:** **3 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How was the current theory of evolution developed? 2. What role does genetics play in evolution? 3. How does the theory of evolution unify or tie together all areas of biology? 4. How do the concepts of "natural selection" and "adaptation" fit together in terms of evolution? 5. What evidence can be found that the Earth has changed over time? 6. What evidence suggests that species changeover time and how is biological classification used to explain relationships among diverse organisms?	• Examine how species change over time. *Evidence for one-celled forms of life, the bacteria, extends back more than 3.5 billion years. The changes in life over time caused dramatic changes in the composition of the Earth's atmosphere, which did not originally contain oxygen.* *Species change over time. Biological change over time is the consequence of the interactions of (1) the potential for a species to increase its numbers, (2) the genetic variability of offspring due to mutation and recombination of genes, (3) a finite supply of the resources required for life, and (4) natural selection. The consequences of change over time provide a scientific explanation for the fossil record of ancient life forms and for the striking molecular similarities observed among the diverse species of living organisms.* *The broad patterns of behavior exhibited by organisms have changed over time through natural selection to ensure reproductive success. Organisms often live in unpredictable environments, so their behavioral responses must be flexible enough to deal with uncertainty and change. Behaviors often have an adaptive logic.* • Examine diversity of organisms and biological classification. *The great diversity of organisms is the result of more than 3.5 billion years of biological change over time that has filled every available niche with life forms. The millions of different species of plants, animals, and microorganisms that live on Earth today are related by descent from common ancestors.*	• Absolute dating • Adaptive radiation • Alfred Russel Wallace • Allele frequency • Analogous structures • Biogenesis • Charles Darwin • Coevolution • Convergent evolution • Divergent evolution • Fossils • Gene pool • Genetic drift • Geologic time • Half-life • Hardy-Weinberg principle • Homologous structures • Isolation • Jean LaMarck • Law of superposition • Migration • Natural selection • Radioactive isotope dating • Sedimentary rock • Sexual selection • Speciation • Spontaneous generation • Thomas Malthus • Vestigial organs	*Students will:* • Investigate geologic time. Construct physical or pictorial models that show subdivisions of geologic time on time lines. Include descriptions of fossils found from each time period. Examine and map coal deposits and other rock • sequences across the state. Create educational brochures describing rock formations that contain fossils and distribute at visitor centers. (WP - Transactive) • Investigate significant geologic events (e.g., mountain building, formation of volcanoes) and their impact on speciation. Research adaptive radiation on Hawaiian and Galapagos Islands. Create maps of islands showing locations of different species. Use graphic organizers to • compare features of species. Develop models to explain how adaptive radiation occurs on island chains. • Do an "Acetate Animal" lab to investigate natural selection. Calculate allele frequencies to observe changes in population of acetate animals after predation. Generate graphs. • Observe organisms from various groups and identify structures as homologous structures/analogous structures and connect structures with convergence/divergence and defend. • Role Play--role play a breeding population using alleles that when joined can be lethal thereby eliminating specific genotypes. Investigate gene frequency changes that result. Use Hardy-Weinberg principle to demonstrate the change. *(Continued next page)*

	• Investigate how to estimate geologic time (e.g., observing rock sequences, radioactive dating). • Examine and interpret ongoing changes of the Earth system (e.g., earthquakes, mountain building). *Interactions among the solid Earth, the oceans, the atmosphere, and living things have resulted in the ongoing development of a changing Earth system. Earthquakes and volcanic eruptions can be observed on a human time scale, but many processes, such as mountain building and plate movements, take place over hundreds of millions of years.* *Techniques used to estimate geological time include using radioactive dating, observing rock sequences, and comparing fossils to correlate the rock sequences at various locations.*		• Role play a breeding population as in activity above only this time assign a specific genotype to be sexually selected for over others. Investigate gene frequency changes, Hardy-Weinberg, etc.

Course/Grade **Biology Grade 10** **Unit:** *Taxonomy/Classification* **Suggested Length:** **2 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. Why is it important for scientists to use a universal system for classification of organisms? 2. What role does the classification of organisms play in the study of the earth's diverse life forms? 3. What taxa make up the classification system developed by Linneaus?	• Examine diversity of organisms and biological classification. *Biological classifications are based on how organisms are related. Organisms are classified into a hierarchy of groups and subgroups based on similarities that, reflect their relationships. Species is the most fundamental unit of classification. Different species are classified by the comparison and analysis of their internal and external structures and the similarity of their chemical processes.*	• Animalia • Binomial nomenclature • Biosystematics • Carolus Linnaeus • Class • Common names • Dichotomous key • Family • Fungi • Genus • Kingdom • Monera • Order • Phylogeny • Phylum • Plantae • Protista • Scientific names • Species • Taxon	*Students will:* • Classify Screws—group, name, and classify a collection of screws (or similar everyday objects), and construct a dichotomous key. • Use a dichotomous key to successfully identify various organisms, e.g., trees, wildflowers, aquatic insects, fishes, etc. • Examine diversity and unity of organisms. Observe organisms in areas close to school. Sort organisms by structure and develop classification system. • Explore methods of classifying organisms based on structure, function, biochemistry, behavior, nutrition, embryonic development, genetic systems, evolutionary histories, and ecological interactions. Classify various organisms based on pictures and measurements of features (e.g., body form, teeth, skull, feet, skeletal features, body temperature, heart, embryonic development). • How Science Classifies—investigate systems of classification other than those biological and identify the criteria on which these systems are based. How are they similar/dissimilar to biological taxonomic systems.

Course/Grade **Biology Grade10** **Unit:** *Life Survey* **Suggested Length:** **7 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How does the cell theory help mold our ideas about biology? 2. How do viruses reproduce and what role do they play in the lives of living organisms? 3. What are some of the various survival strategies of bacteria and what role do they play in the biosphere? 4. How are protists unique from other kingdoms and what role do they play in the biosphere? 5. What are the unique structures of various groups of fungi and what role do fungi play in the biosphere?	• Investigate behavioral responses to internal changes and external stimuli. • Analyze how patterns of behavior ensure reproductive success. • Examine diversity of organisms and biological classification. *Biological classifications are based on how organisms are related. Organisms are classified into a hierarchy of groups and subgroups based on similarities that, reflect their relationships. Species is the most fundamental unit of classification. Different species are classified by the comparison and analysis of their internal and external structures and the similarity of their chemical processes.* *The great diversity of organisms is the result of more than 3.5 billion years of biological change over time that has filled every available niche with life forms. The millions of different species of plants, animals, and microorganisms that live on Earth today are related by descent from common ancestors.* • Examine interrelationships and interdependencies of organisms in ecosystems and the factors that influence the interactions between organisms.	• Alternation of generation • Angiosperms • Anther • Antibiotic • Apical meristem • Auxin • Bacteria • Basidiocarp • Cambium • Coenocytic • Conjugaion • Contractile vacoule • Cotyledon • Cuticle • Cyanobacteria • Dicot • Ectoplasm • Endoplasm • Endospores • Endosymbiont • Endotoxin • Epidermis • Exotoxin • Extremophiles • Eyespot • Facultative bacteria • Fruit • Fungi • Gametophyte • Gram stain • Gravitroprism • Guard cells • Gymnosperm • Hydrotropism • Hyphae • Lichens	*Students will:* • Explore methods of classifying organisms based on structure, function, biochemistry, behavior, nutrition, embryonic development, genetic systems, evolutionary histories, and ecological interactions. Classify various organisms based on pictures and measurements of features (e.g., body form, teeth, skull, feet, skeletal features, body temperature, heart, embryonic development). • Explore diversity among microorganisms. Research types of aerobic and anaerobic bacteria (e.g., Staphylococcus aureus, Clostridium botulinum). Discuss potential impacts on human health (e.g., botulism, vitamin K production). Research and categorize antimicrobial drugs. Investigate how antimicrobial drugs disrupt cell processes or structures or both. Create informational brochures explaining how antimicrobial drugs work and distribute at drugstores. • Infectious Diseases--conduct an activity that illustrates the spread of infectious diseases by simulating the exchange of body fluids. Stimulate a discussion about infectious diseases and their impact on human health and society. • Examine diversity among plants. Identify major highlights of plant evolution (e.g., vascular tissue) and their impact on plant diversification. Identify divisions within plant kingdom and describe their characteristics and significant adaptations. Use graphic organizers to compare characteristics. Create bulletin boards, collages, or multimedia presentations on the economic or medical importance of plants from each division, including local agricultural products. *(Continued next page)*

6. How are various plants structurally and functionally adapted to their environments and what roles do they play in their communities? 7. How do the selected structures of various animals support life functions? What similarities do those structures share across species? 8. How does animal behavior and stimuli responses aid in their survival?		• Lysogenic cycle • Lytic cycle • Macro/micronucleus • Monocot • Mycelium • Mycorrhiza • Obligate aerobes • Obligate anaerobes • Ovule • Pathgenic • Pellicle • Petal • Phage • Phloem • phototropism • Pilus • Pistil • Plankton • Plant organs • Plasmid • Pollen • Pollination • Prions • Prophage • Psuedopodia • Retrovirus • Rhiziod • Secondary growth • Spore • Sporophyte • Stamen • Stolon • Stomates • Style • Temperate phage • Transduction • Transpiration • Vascular • Viroid • Virus • Xylem • Yeast	• Examine various preserved specimens of representative animals from important taxa to establish comparative anatomies and physiologies. • Explore loss of biodiversity locally. Investigate why • regional habitats are being destroyed at alarming rates. • Debate whether or not corporations or private landowners have the right develop land without restrictions. Make suggestions as to better handle development in light of biodiversity issues. (WP-Transactive) • Explore circadian rhythms (e.g., metabolic role, body temperature, feeding times) and cirannual behaviors (e.g., breeding, hibernation). Investigate behavioral responses of organisms in tidal regions. Identify internal or external cues that regulate these behaviors and explore their adaptive nature.

High School Science Curriculum
Chemistry I -Grade 11

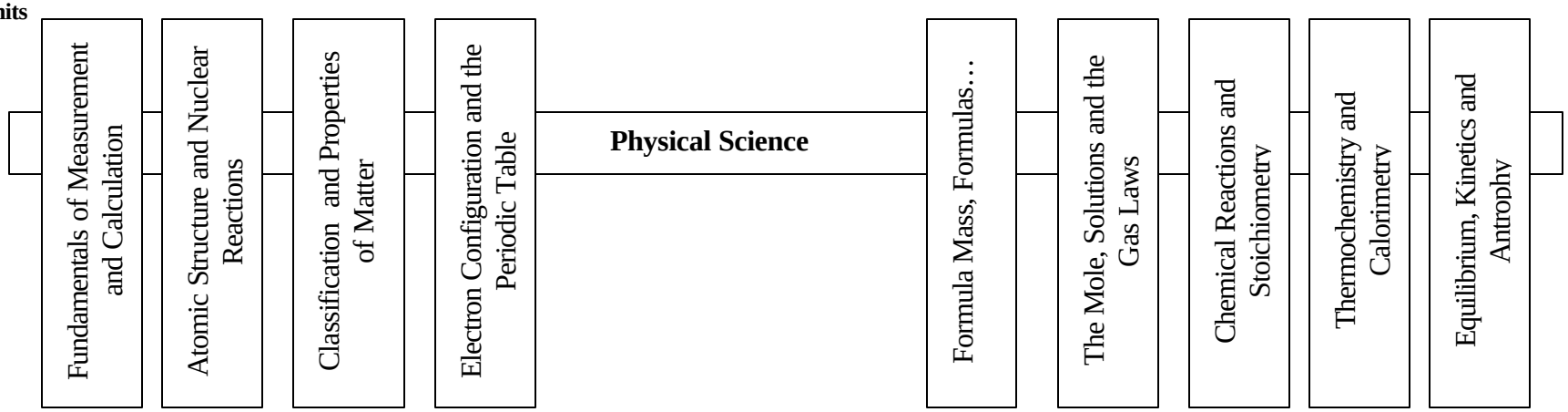
Description

Chemistry I is designed for students who need chemistry as a prerequisite in continuing their formal education. Students who plan careers in the medical, veterinary, engineering, or other science intensive professions should take this course. The emphasis of Chemistry I is on principles and concepts rather than on the relationship of technology and society. Chemistry I also differs from Chem Com in its more rigorous mathematical procedures. About 15% of the time is allotted to laboratory work. This course will serve as preparation for an introductory college chemistry course.

Goal

The goal of Chemistry I is to lay a foundation for further investigations in the physical and biological sciences. To this end, basic chemical concepts are explored with emphasis on cause and effect, mathematical relationships of pertinent variables are explored, and laboratory procedures are designed and applied for the investigation of the variable relationships. The questions below follow from this emphasis.

Units



Course Questions

A. What are the important variables and how are they related?
B. How does micro-structure produce macro properties?
C. How do you investigate the properties in the laboratory?

Course/Grade **Chemistry I Grade 11** **Unit:** *Fundamentals of Measurement and Calculation* **Suggested Length:** **3 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. What is precision? 2. What is accuracy? 3. How do you determine the precision of a measurement? 4. How do you determine the precision of a derived result? 5. What are the names and symbols of important elements? 6. What are metric units? 7. What is the Factor Label method and how do you use it to solve problems?	• Identify and refine questions and identify scientific concepts to guide the design of scientific investigations(PS2.1). *Formulate testable hypotheses and demonstrate the logical connections between the scientific concepts guiding a hypothesis and the design of an experiment.* • Use equipment, techniques, technology, and mathematics to improve scientific investigations and communications. *Use equipment, tools, techniques, technology, and mathematics to improve scientific investigations and communications.* • Communicate designs, procedures, and results of scientific investigations. *Communicate and defend the designs, procedures, observations, and results of scientific investigations.*	• Factor label method. – Why the factor-label method works. – Use of factor-label method to solve problems, e.g. metric conversions. • Metric – Review of metric units for mass, length, volume, etc. – Conversion among metric units, e.g. cm to mm. – Conversion of selected English to metric units. – Calculation of derived result from metric data, e.g. mass and volume to density. • Elements – Element names and symbols.	*Students will:* • Convert metric units to the correct number of significant figures. • Convert between selected English and metric units. • Use the factor-label method to solve problems. • Perform experiments in which they measure physical objects, perform calculations on the data and report the results to the correct number of significant figures. • Know the symbols and names of important elements. • Discuss possible situations where mistakes in determining the number of significant figures would result in unforeseen of undesirable consequences. • Using the TI-83 or similar calculator, determine the standard deviation, mean median, etc. values for a set of measurements.

Course/Grade **Chemistry I Grade 11** **Unit:** *Atomic Structure and Nuclear Reactions* **Suggested Length:** **3 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. What is the structure of the atom? 2. What is an isotope? 3. Why do nuclear reactions occur? 4. What are the types of nuclear reactions? 5. How do you balance nuclear reactions? 6. How do you detect nuclear processes? 7. How are nuclear processes used and how do they affect society? 8. How did the elements originate?	• Use equipment (e.g. microscopes, lasers), tools (e.g., beakers), techniques (e.g., microscopic skills), technology (e.g. computers), and mathematics to improve scientific investigations and communications. *Use equipment, tools, techniques, technology, and mathematics to improve scientific investigations and communications.* • Communicate designs, procedures, and results of scientific investigations *Design and conduct different kinds of scientific investigations.* • Examine nuclear structure, nuclear forces, and nuclear reactions (e.g., fission, fusion, radioactivity *The forces that hold the nucleus together, at nuclear distances, are usually stronger that the forces that would make it fly apart. Nuclear reactions convert a fraction of the mass of interacting particles into energy, and they can release much greater amounts of energy than atomic interactions. Fission is the splitting of a large nucleus into smaller pieces. Fusion is the joining of two nuclei at extremely high temperature and pressure.* *Fusion is the process responsible for the energy of the Sun and other stars.* • Describe the formation of the stars. *Early in the history of the universe, the first atoms to form were mainly hydrogen and helium. Over time, these elements clump together by gravitational attraction to form trillions of stars.* • Examine stars (e.g., energy production, formation of elements.) *Stars have life cycles of birth through death that are analogous to those of living organisms. During their lifetimes, stars generate energy form nuclear fusion reactions that create successively heavier chemical elements. Some stars explode at the end of their lives, and the heavy elements they have created are blasted out into space to form the next generation of stars and planets.*	• Subatomic structure of the atom – Determination of number of electrons, protons, and neutrons from the symbol. – Determination of symbol from number of electrons, neutrons and protons. • Nuclear reactions – Balance nuclear reactions. – Description of properties of subatomic particles derived from nuclear processes, e.g., alpha particles, beta particles etc. – Half lives. – Use of nuclear processes. – Societal issues. • Origin of elements. – Description of solar processes which produce energy.	*Students will:* • Correctly balance nuclear processes. • Know characteristics of subatomic particles. • Defend a position concerning use of nuclear processes in society. • Perform experiment using a cloud chamber. • Determine number of half-lives from available data. • Analyze data derived from a rate meter • Discuss pros and cons of production of radioactive isotopes. • Interview representative from Navy about opportunities in nuclear engineering. *(Continued next page)*

	• Analyze atomic structure and electric forces. • Matter is made of minute particles called atoms, and atoms are composed of even smaller components. The components of an atom have measurable properties such as mass and electrical charge. Each atom has a positively charged nucleus surrounded by negatively charged electrons. The electric force between the nucleus and the electrons holds the atom together. • The atom's nucleus is composed of protons and neutrons that are much more massive than electrons. When an element has atoms that differ in the number of neutrons, these atoms are called different isotopes of the element.	– Birth and death of stars and the production of the heavier elements.	

Course/Grade **Chemistry I Grade 11** **Unit:** *Classification and Properties of Matter* **Suggested Length:** **3 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How is matter classified? 2. What characteristics distinguish the various types of matter? 3. What is the difference between a physical and chemical property or process? 4. How do you determine the type of matter? 5. How are mixtures separated? 6. What are states of matter.	• Use equipment (e.g. microscopes, lasers), tools (e.g., beakers), techniques (e.g., microscopic skills), technology (e.g. computers), and mathematics to improve scientific investigations and communications. *Use equipment, tools, techniques, technology, and mathematics to improve scientific investigations and communications.* • Communicate designs, procedures, and results of scientific investigations. *Communicate and defend the designs, procedures, observations, and results of scientific investigations.* • Design and conduct different kinds of scientific investigations for a wide variety of reasons. *Design and conduct different kinds of scientific investigations.* • Investigate how the structure of matter (e.g., constituent atoms, distances and angles between atoms) relates to physical properties of matter. *Bonds between atoms are created when outer electrons are paired by being transferred or shared. A compound is formed when two or more kinds of atoms bind together chemically.* *The physical properties of compounds reflect the nature of the interactions among molecules. These interactions are determined by the structure of the molecule including the constituent atoms.* *Solids, liquids, and gases differ in the distances between molecules or atoms and therefore the energy that binds them together. In solids, the structure is nearly rigid; in liquids, molecules or atoms move around each other but do not move apart; and in gases, molecules or atoms move almost independently of each other and are relatively far apart.*	• Matter classification scheme. – Compound. – Element. – Homogeneous mixture. – Heterogeneous mixture. • Separation techniques, e.g., chromatography, distillation, filtration, etc. • Properties or Processes – Physical, e.g., mp, bp, color, etc. – Chemical, e.g., oxidation, digestion, etc. • Introduction to states of matter.	*Students will:* • Identify type of matter based on chemical and physical characteristics. • Perform experiments or observations to determine type of matter. • Distinguish between chemical and physical properties or processes. • Perform separation of mixtures. • Describe the steps in determining the state and type of matter. • Discuss impact of DNA fingerprinting as an analytical tool. • Use CBL to determine conductivity of solutions (physical property). • Use density to identify unknown. • Use melting point to identify unknown. • Use CBL to illustrate differences in boiling point.

Course/Grade **Chemistry I Grade 11** **Unit:** *Electron Configuration and the Periodic Table* **Suggested Length:** **3 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How do you determine the electron configuration of an element or ion? 2. What are quantum numbers and what information is expressed by quantum numbers? 3. How are quantum numbers related to orbitals? 4. How was the periodic table devised and how is it arranged.? 5. What is the atomic (electronic) basis for the structure of the periodic table? 6. What are the periodic trends and why do they exist? 7. How are chemical properties predicted by the electron configuration? 8. How can electromagnetic	• Use equipment (e.g. microscopes, lasers), tools (e.g., beakers), techniques (e.g., microscopic skills), technology (e.g. computers), and mathematics to improve scientific investigations and communications. *Use equipment, tools, techniques, technology, and mathematics to improve scientific investigations and communications.* • Communicate designs, procedures, and results of scientific investigations. *Communicate and defend the designs, procedures, observations, and results of scientific investigations.* • Analyze atomic structure and electric forces. *Matter is made of minute particles called atoms, and atoms are composed of even smaller components. The components of an atom have measurable properties such as mass and electrical charge. Each atom has a positively charged nucleus surrounded by negatively charged electrons. The electric force between the nucleus and the electrons holds the atom together.* *The atom's nucleus is composed of protons and neutrons that are much more massive than electrons. When an element has atoms that differ in the number of neutrons, these atoms are called different isotopes of the element.* • Examine how energy is transferred (e.g., collisions light waves) and recognize that the universe is constant. *The total energy of the universe is constant. Energy can be transferred in many ways, but it can neither be created nor destroyed.*	• Electron configuration. – Determination for atoms and ions. – Predicting ion formed from electron configuration. – Atom emission • Periodic table – Families, family names, and family characteristics. – Trends: electron affinity, ionization energy, size, electronegativity • Quantum Numbers – Explanation of four quantum numbers. – Determination of electron orbital from quantum numbers.	*Students will:* • Determine quantum numbers from electron orbital. • Determine orbital from quantum number. • Predict chemical characteristics from electron configuration. • Predict electron configuration from chemical data. • Determine chemical family from chemical characteristics. • Use spectrometer to investigate atomic emission. • Discuss how a person would determine to which group a "new" element would belong. *(Continued next page)*

radiation be used to investigate electron configuration?	• Distinguish between types of energy (e.g., kinetic energy, potential energy, energy fields). *All energy can be considered to be either kinetic energy, potential energy, or energy contained by a field (e.g. electric, magnetic, gravitational).* • Investigate how the structure of matter (e.g., outer electrons, type of bond) relates to chemical properties of matter. *Atoms interact with each other by transferring or sharing outermost electrons. These outer electrons govern the chemical properties of the element.* *An element is composed of a single type of atom. When elements are listed according to the number of protons, repeating patterns of physical and chemical properties identify families of elements with similar properties. The periodic table is a consequence of the repeating pattern of outermost electrons.*		

Course/Grade **Chemistry I Grade 11** **Unit:** *Formula Mass, Formulas, Naming, Types of Intramolecular Bonds, Shapes, Polarity and Intramolecular Forces* **Suggested Length:** **4 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. What are the types of intermolecular bonds? 2. What physical properties result from these bonds? 3. How do you determine molecular shapes? 4. How do you predict the formulas of ionic compounds? 5. How do you determine empirical formulas of molecules? 6. How do you determine molecular formulas? 7. How do you name compounds? 8. What are the states of matter and how do micro forces predict macro properties? 9. How do you predict intermolecular bonding and physical properties from molecular shapes? 10. What information can be obtained from a phase diagram? 11. What is organic chemistry?	• Use equipment (e.g. microscopes, lasers), tools (e.g., beakers), techniques (e.g., microscopic skills), technology (e.g. computers), and mathematics to improve scientific investigations and communications(PS2.1). *Use equipment, tools, techniques, technology, and mathematics to improve scientific investigations and communications.* • Communicate designs, procedures, and results of scientific investigations. *Communicate and defend the designs, procedures, observations, and results of scientific investigations.* • Investigate how the structure of matter (e.g., constituent atoms, distances and angles between atoms) relates to physical properties of matter. *Bonds between atoms are created when outer electrons are paired by being transferred or shared. A compound is formed when two or more kinds of atoms bind together chemically.* *The physical properties of compounds reflect the nature of the interactions among molecules. These interactions are determined by the structure of the molecule including the constituent atoms.* *Solids, liquids, and gases differ in the distances between molecules or atoms and therefore the energy that binds them together. In solids, the structure is nearly rigid; in liquids, molecules or atoms move around each other but do not move apart; and in gases, molecules or atoms move almost independently of each other and are relatively far apart.*	• Formulas and Naming – Empirical – Molecular – Ionic – Covalent (e.g. organic) • Types solids and States of Matter – Macro properties from micro forces. – Gas, Liquid, Solid – Metallic, molecular, ionic, covalent network • Shapes – Lewis structure – Electron structure – Molecular structure – Polarity – Isomers • Intermolecular forces in molecular compounds. – Dispersion – Hydrogen bonding – Dipole-dipole • Phase Diagram – Phase transition names – Important locations on the phase diagram – Determination of relative density of solid vs. liquid by inspection of phase diagram – Determination of transition temperature at specified pressure – Determination of phase at specified temperature and pressure.	*Students will:* • Produce correct formulas for ionic compounds. • Determine type of solid from physical property data. • Predict physical properties from knowledge of type of solid. • Experimentally investigate physical properties of solids. • Determine empirical and molecular formulas from data. • Make models of molecules/ions. • Produce Lewis structures, electronic structures, and molecular structures from molecular/ionic formulas (or names). • Correctly name compounds from formulas and produce correct formulas from names. • Determine the number of possible isomers for a specified formula. • Discuss the changes (evolution, recreation, climate, etc.) if the density of ice were higher than the density of liquid water. • Identify the "type" of solid from physical properties determined in lab.

Course/Grade **Chemistry I Grade 11** **Unit:** *The Mole, Solutions and the Gas Laws* **Suggested Length:** **4 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. What is the mole and why was it created? 2. What are the most often used concentration units? 3. How do you produce a solution of desired concentration? 4. How do you prepare a solution with a specific physical property? 5. If a solution exhibits a specific property, how do you determine the concentration? 6. How do you determine the concentration of (i.e., analyze) a solution? 7. Why does a substances dissolve (or fail to dissolve) in another substance? 8. What is a colligative property and why is it important? 9. What are the relationships among the variables which effect gases? 10. How do gases differ from liquids and solids?	• Use equipment (e.g. microscopes, lasers), tools (e.g., beakers), techniques (e.g., microscopic skills), technology (e.g. computers), and mathematics to improve scientific investigations and communications. *Use equipment, tools, techniques, technology, and mathematics to improve scientific investigations and communications.* • Communicate designs, procedures, and results of scientific investigations. *Communicate and defend the designs, procedures, observations, and results of scientific investigations.* • Investigate how the structure of matter (e.g., constituent atoms, distances and angles between atoms) relates to physical properties of matter. *The physical properties of compounds reflect the nature of the interactions among molecules. These interactions are determined by the structure of the molecule including the constituent atoms.* *Solids, liquids, and gases differ in the distances between molecules or atoms and therefore the energy that binds them together. In solids, the structure is nearly rigid; in liquids, molecules or atoms move around each other but do not move apart; and in gases, molecules or atoms move almost independently of each other and are relatively far apart.*	• The mole – Molar mass – Formula mass – AMU • Solutions – Solute – Solvent – Solution – Solubility – Molarity – Molality – % by mass or volume – Freezing point depression. – Boiling point elevation – Osmotic pressure – Beer's Law – Colligative property • Gases – P-V-T relationships – Equal volumes = equal moles	*Students will:* • Determine colligative properties • Dilute and/or concentrate solutions. • Prepare solutions and determine concentrations (molarity, molality, %, etc.) • Determine solubilities. • Calculate concentrations. • Determine the molecular mass from colligative property data. • Determine molecular masses from formulas. • Investigate Temperature vs. Pressure using CBL. • Investigate Pressure vs. Volume with using CBL • Determine concentration of unknown using CBL with colorimeter. • Discuss the pros and cons of using sodium chloride to treat roads and sidewalks.

Course/Grade **Chemistry I Grade 11** **Unit:** *Chemical Reactions and Stoichiometry* **Suggested Length:** **4 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How are reactions categorized? 2. How do you balance reactions by inspection? 3. How do you know what products will be produced? 4. How do you determine the amount of product if you are given a specified amount of reactants? 5. How do you know how much reactant to add to produce a specified amount of product? 6. How do you determine if something is an acid or a base? 7. How do you determine pH from concentration? 8. How do you determine concentration from pH? 9. How do you test for pH.	• Use equipment (e.g. microscopes, lasers), tools (e.g., beakers), techniques (e.g., microscopic skills), technology (e.g. computers), and mathematics to improve scientific investigations and communications. *Use equipment, tools, techniques, technology, and mathematics to improve scientific investigations and communications.* • Communicate designs, procedures, and results of scientific investigations. *Communicate and defend the designs, procedures, observations, and results of scientific investigations.* • Investigate chemical reactions and the release or consumption of energy. Chemical reactions occur all around us and in every cell in our bodies. These reactions may release or consume energy. Rates of chemical reactions vary. Reaction rates depend on concentration, temperature, and properties of reactants. Catalysts speed up chemical reactions. • Examine the transfer of electrons or hydrogen ions between reacting ions, molecules, or atoms.	• Reactions – Predicting products – Decomposition – Synthesis – Single replacement – Double replacement – Combustion – Acid-Base – Oxidation Reduction – Oxidation number – Balancing • Stoichiometry – Limiting reactant – % yield – Theoretical yield • Acid-Base – pH – Buffer – Conjugate acid – Conjugate base – Products which contain acids and bases. – Biological acids and bases – Acid-base indicators	*Students will:* • Determine pH from concentration data • Determine concentration from pH data. • Investigate pH of commercial and/or natural products. • Identify type of reaction if given reactants and products. • Determine products if given type of reaction. • Use oxidation numbers. • Determine species oxidized and/or reduced. • Discuss importance of buffers. • Perform experiment and determine % yield. • Identify acids/bases from formula or molecular structure. • Determine pH of common household and/or environmental samples. • Discuss why metals are used although most are easily oxidized. • Discuss the advisability of being on the "gold" standard.

Course/Grade **Chemistry I Grade 11** **Unit:** *Thermochemistry and Calorimetry* **Suggested Length:** **3 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How does the temperature of a system vary when heat added to the system? 2. How do you determine the amount of heat produced or consumed? 3. Will heat be produced or consumed during a phase transition? 4. What is the relationship between temperature change and the change in potential or kinetic energy.	• Use equipment (e.g. microscopes, lasers), tools (e.g., beakers), techniques (e.g., microscopic skills), technology (e.g. computers), and mathematics to improve scientific investigations and communications. • *Use equipment, tools, techniques, technology, and mathematics to improve scientific investigations and communications.* • Communicate designs, procedures, and results of scientific investigations. • *Communicate and defend the designs, procedures, observations, and results of scientific investigations.* • Investigate chemical reactions and the release or consumption of energy. • *Chemical reactions occur all around us and in every cell in our bodies. These reactions may release or consume energy. Rates of chemical reactions vary. Reaction rates depend on concentration, temperature, and properties of reactants. Catalysts speed up chemical reactions.* • Distinguish between types of energy (e.g., kinetic energy, potential energy, energy fields). • *All energy can be considered to be either kinetic energy, potential energy, or energy contained by a field (e.g. electric, magnetic, gravitational).* • Examine how everything tends to become less organized and less orderly over time (e.g., heat moves from hotter to cooler objects). • *Heat is the manifestation of the random motion and vibrations of atoms, molecules, and ions. The greater the atomic or molecular motion, the higher the temperature.*	• Calorimetry • Chemical energy • Endothermic • Enthalpy • Exothermic • Heat added vs. temperature curve. • Heat capacity • Hess's Law • Kinetic energy • Phase changes • Potential energy • Specific heat • The calorimeter	*Students will:* • Construct a calorimeter • Measure the heat produced or consumed during a phase change or reaction. • Use Hess's Law to determine the amount of heat will be produced or consumed by a reaction. • Use the heat of reaction to predict how much heat will be produced or consumed by a specified amount of reactants. • Use CBL to determine enthalpy of a reaction. • Use CBL to determine the heat of fusion of water. • Use CBL to determine the specific heat of a metal. • Discuss if the "Heat Death of the Universe" will occur.

Course/Grade **Chemistry I Grade 11** **Unit:** *Equilibrium, Kinetics and Antrophy* **Suggested Length:** **4 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How do you determine the amounts of reactants and products in an equilibrium reaction? 2. How does the equilibrium constant vary with temperature? 3. What variables are important in the speed (kinetics) of a reaction? 4. What is entropy and why is it important? 5. What is a catalyst and why is it important?	• Use equipment (e.g. microscopes, lasers), tools (e.g., beakers), techniques (e.g., microscopic skills), technology (e.g. computers), and mathematics to improve scientific investigations and communications. • *Use equipment, tools, techniques, technology, and mathematics to improve scientific investigations and communications.* • Communicate designs, procedures, and results of scientific investigations. • *Communicate and defend the designs, procedures, observations, and results of scientific investigations.* • Investigate factors (e.g., temperature catalysts) affecting reaction rates. Chemical reactions occur all around us and in every cell in our bodies. These reactions may release or consume energy. Rates of chemical reactions vary. Reaction rates depend on concentration, temperature, and properties of reactants. Catalysts speed up chemical reactions *Rates of chemical reactions vary. Reactions rates depend on concentration, temperature, and properties of reactants. Catalysts speed up chemical reactions.* • Examine how everything tends to become less organized and less orderly over time (e.g., heat moves from hotter to cooler objects). *Heat is the manifestation of the random motion and vibrations of atoms, molecules, and ions. The greater the atomic or molecular motion, the higher the temperature.* *The universal becomes less orderly and less organized over time. Thus, the overall effect is that the energy is spread out uniformly. For example, in the operation of mechanical systems, the useful energy output is always less than the energy input; the difference appears as heat.*	• Equilibrium – Determination of concentration or pressure of reactants and/or products – Effect of addition or removal of heat – The equilibrium constant • Kinetics – What variables are important in kinetics – Speeding up or slowing down a reaction. • Entropy	*Students will:* • Determine an equilibrium constant using CBL. • Using CBL investigate the effect on equilibrium concentrations of reactants and products when a concentration of a reactant or product is modified. • Investigate entropy and show examples. • Investigate some of the variables which affect the speed (kinetics) of a reaction. • Investigate the effect of a catalyst. • Discuss the affect of entropy on extent of reaction. • Discuss if a messy room is an appropriate analogy for entropy

High School Science Curriculum
Chemistry in the Community – Grade 11

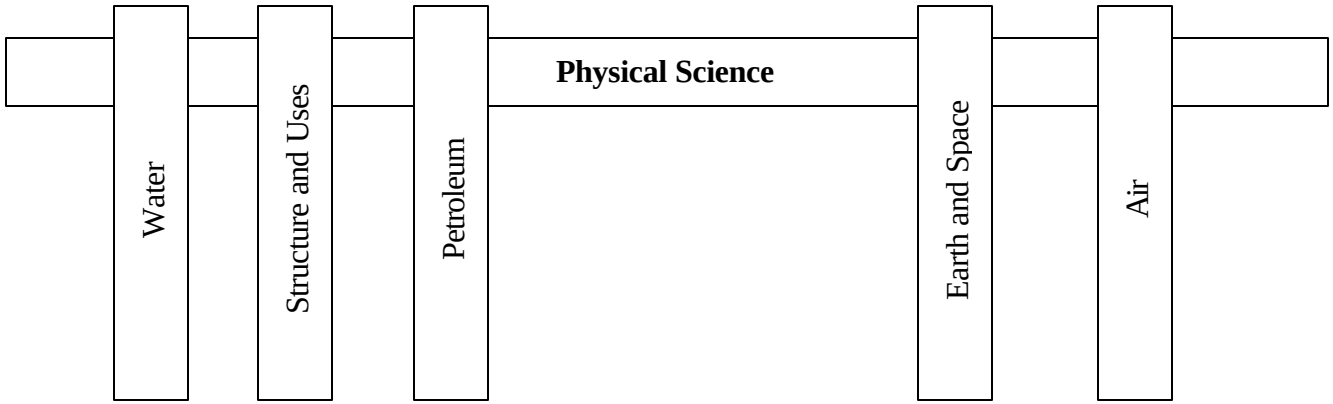
Description

The course is designed for those interested in technical programs or non-science majors. This course also emphasizes how science and society work together. Chemical principles and applications as well as industrial chemistry will be explored. Other topics such as geochemistry and chemistry of the stars will be included. This course is about 15% laboratory work.

Goal

The goal of this course is to help students to understand the importance of chemistry in their lives and to be able to apply skills to make educated decisions regarding scientific issues.

Units



Course Questions

A. How can one recognize and understand the importance and impact that chemical principles have on our lives?
B. How can problem-solving skills and critical thinking skills be used to make informed choices regarding scientific and technological issues?
C. What are the potential as well as the limitations of science and technology?

Throughout the course emphasis is placed on the Program of Studies (PS) and the corresponding Core Content items below:

- (PS) Apply scientific inquiry and conceptual understandings to solving problems of technological design (e.g., styrofoam cups, transistors, computer chips).
  (PS) Examine the interaction between science and technology.
  (CC) Apply scientific theory and conceptual understandings to solve problems of technological design and examine the interaction between science and technology.
- (PS)Explore the impact of scientific knowledge and discoveries on personal and community health.
  (PS)Recognize how science influences human population growth.
  (PS)Use science to analyze the use of natural resources by an increasing human population.
  (PS)Investigate how science can be used to solve environmental quality problems (e.g., over consumption, food distribution).
  (PS)Use science to investigate natural hazards and human-induced hazards.
  (PS)Analyze how science and technology are necessary but not sufficient for solving local, national, and global issues.
  (CC)Explore the impact of scientific knowledge and discoveries on personal and community health; recognize how science influences human population growth, use science to analyze the use of natural resources by an increasing human population; investigate how science can be used to solve environmental quality problems, use science t investigate natural and human-induced hazards; and analyze how science and technology are necessary but not sufficient for solving local, national, and global issues.
- (PS)Analyze the role science plays in everyday life and compare different careers in science.
- (PS)Recognize that scientific knowledge comes from empirical standards, logical arguments, and skepticism, and is subject to change as new evidence becomes available.
- (PS)Investigate advances in science and technology that have important and long-lasting effects on science and society (e.g., Newtonian mechanics, plate tectonics, germ theory, medical and health technology).
  (CC)Analyze the role science plays in everyday life and compare different careers in science; recognize that scientific knowledge comes from empirical standards, logical arguments, and skepticism, and is subject to change as new evidence becomes available; and investigate advances in science and technology that have important and long-lasting effects on science and society.

Course/Grade **Chem Comm Grade 11** **Unit:** *Water* **Suggested Length:** **10 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. Can we continue to obtain enough water to supply our needs? 2. How can we get sufficient pure water? 3. How do everyday decisions affect the quality and quantity of water supplies? 4. How can chemistry help explain water's personal and social importance?	• Investigate structure and chemical properties of matter. *Atoms interact with each other by transferring or sharing outermost electrons. These outer electrons govern the chemical properties of the element. An element is composed of a single type of atom. When elements are listed according to the number of protons, repeating patterns of physical and chemical properties identify families of elements with similar properties. The periodic table is a consequence of the repeating pattern of outermost electrons.* *The physical properties of compounds reflect the nature of the interactions among molecules. These interactions are determined by the structure of the molecule including the constituent atoms.* *Solids, liquids, and gases differ in the distances between molecules or atoms and therefore the energy that binds them together. In solids, the structure is nearly rigid; in liquids, molecules or atoms move around each other but do not move apart; and in gases, molecules or atoms move almost independently of each other and are relatively far apart.* • Analyze atomic structure *Matter is made of minute particles called atoms, and atoms are composed of even smaller components. The components of an atom have measurable properties such as mass and electrical charge. Each atom has a positively charged nucleus surrounded by negatively charged electrons. The electric force between the nucleus and the electrons holds the atom together.* • Investigate electrical energy and conductivity through matter *In conducting materials, electrons flow easily: whereas in insulating materials, they can hardly flow at all. Semiconducting materials have intermediate behavior. At low temperatures, some materials become superconductors and offer no resistance to the flow of*	Acids and bases and pH • Chemical analysis • Chemical bonding • Elements and compounds • Industrial chemistry • Metric/Scale • Nomenclature • Physical and chemical properties • Solids, liquids and gases • Solutions and solubility	*Students will:* • Measure and convert units. • Purify a sample of water. • Keep a diary of water use and suggest ways family could cut down on use. • Classify water mixtures as colloid, solution or suspension. • Compare density of various substances. • Test for the presence of various ions in solution. • Using CBL's compare the conductivity of tap, distilled and creek water. • Compare solubility of various substances. • Use a CBL to conduct a DO test and describe the relationship of temperature with DO and graph data • Alter the pH of aquatic species and observe changes in growth or behavior. • Hold a debate on an environmental issue such as water quality. • Formulate a tentative conclusion based on limited data. Differentiate between correlation and cause and effect relationships. • Represent an idea, structure or system with various models. • Analyze the amount of vitamin C in various substances via titration using a CBL. Write a letter to any company that demonstrates a discrepancy (Portfolio). • Compare the pH of different substances. • Describe conditions to overload the bodies buffer system and discuss the chemistry involved. Conduct an experiment with a buffer. *(Continued next page)*

	electrons. • Analyze the role science plays in everyday life situations *Analyze the role science plays in everyday life and compare different careers in science; recognize that scientific knowledge comes from empirical standards, logical arguments, and skepticism, and is subject to change as new evidence becomes available; and investigate advances in science and technology that have important and long-lasting effects on science and society.* • Explore the impact of scientific discoveries on personal and community health *Explore the impact of scientific knowledge and discoveries on personal and community health; recognize how science influences human population growth, use science to analyze the use of natural resources by an increasing human population; investigate how science can be used to solve environmental quality problems, use science t investigate natural and human-induced hazards; and analyze how science and technology are necessary but* not sufficient for solving local, national, and global issues. • Review and analyze scientific data. *Formulate testable hypotheses and demonstrate the logical connections between concepts and guiding a hypothesis and the design of an experiment* *Use equipment, tools, techniques, technology and mathematics to improve scientific investigations and communications* *Use logic and knowledge to develop and revise scientific models* *Review and analyze scientific investigations and explanations*		

Course/Grade **Chem Comm Grade 11** **Unit:** *Structure and Uses* **Suggested Length:** **6 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. Do we have enough resources to meet future human needs? 2. How is chemistry used to extract metals from ores? 3. How can chemistry help create new alternatives for scarce material? 4. What can be done about growing waste disposal? 5. How does chemistry explain similarities and differences among substances?	• Analyze atomic structure and electric forces *Matter is made of minute particles called atoms, and atoms are composed of even smaller components. The components of an atom have measurable properties such as mass and electrical charge. Each atom has a positively charged nucleus surrounded by negatively charged electrons. The electric force between the nucleus and the electrons holds the atom together.* • Investigate how the structure of matter relates to chemical properties of matter *Atoms interact with each other by transferring or sharing outermost electrons. These outer electrons govern the chemical properties of the element.* *An element is composed of a single type of atom. When elements are listed according to the number of protons, repeating patterns of physical and chemical properties identify families of elements with similar properties. The periodic table is a consequence of the repeating pattern of outermost electrons.* • Investigate how the structure of matter relates to physical properties of matter. *Bonds between atoms are created when outer electrons are paired by being transferred or shared. A compound is formed when two or more kinds of atoms bind together chemically.* *The physical properties of compounds reflect the nature of the interactions among molecules. These interactions are determined by the structure of the molecule including the constituent atoms.*	Atomic structure • Chemical analysis • Chemical bonding • Elements and compounds • Energy relationships • Formula and equation writing • Industrial chemistry • Metrics/Scale • Mole concept • Nomenclature • Periodicity • Physical and chemical properties • Solids, liquids and gases • Solutions • Stoichiometry	*Students will:* • Make a silver or copper penny through a simple reaction. • Design and conduct a test to confirm the law of conservation of mass. • Formulate a list of common objects used daily and analyze the resources involved in its manufacturing, and report the results to a specific audience. • Conduct an experiment to observe and compare the chemical and physical changes of matter. • Compare the properties of various elements through chemical and physical tests (i.e. Conductivity, hardness, malleability). • Conduct a test to observe the concept of periodicity of a family of elements. • Compare the reactivity of metals and explain how this would influence the market value of a metal. • Conduct an experiment to determine % yield of a reaction and relate to limiting reactants.

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	Solids, liquids, and gases differ in the distances between molecules or atoms and therefore the energy that binds them together. In solids, the structure is nearly rigid; in liquids, molecules or atoms move around each other but do not move apart; and in gases, molecules or atoms move almost independently of each other and are relatively far apart. • Examine the transfer of electrons between reacting ions, molecules or atoms. *Bonds between atoms are created when outer electrons are paired by being transferred or shared. A compound is formed when two or more kinds of atoms bind together chemically.* • Apply scientific inquiry and conceptual understandings to solve problems *Apply scientific theory and conceptual understandings to solve problems of technological design and examine the interaction between science and technology* • Investigate how science can be used to solve environmental quality problems *Explore the impact of scientific knowledge and discoveries on personal and community health; recognize how science influences human population growth, use science to analyze the use of natural resources by an increasing human population; investigate how science can be used to solve environmental quality problems, use science t investigate natural and human-induced hazards; and analyze how science and technology are necessary but not sufficient for solving local, national, and global issues.* • Design and conduct different scientific investigations. *Formulate testable hypotheses and demonstrate the logical connections between the scientific concepts guiding as hypothesis and the design of the experiment.* *Use equipment, tools, technology, and mathematics to improve scientific investigations and communications.*		

Course/Grade **Chem Comm Grade 11** **Unit:** *Petroleum* **Suggested Length:** **6 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How can we make the best use of the petroleum still remaining? 2. How can we find satisfactory alternatives to petroleum? 3. How does petroleum have a dual role as both a fuel and a raw material from which other substances can be made?	• Use science to analyze the use of natural resources as human population increases. *Explore the impact of scientific knowledge and discoveries on personal and community health; recognize how science influences human population growth, use science to analyze the use of natural resources by an increasing human population; investigate how science can be used to solve environmental quality problems, use science t investigate natural and human-induced hazards; and analyze how science and technology are necessary but not sufficient for solving local, national, and global issues*. • Investigate structure and chemical properties of matter *Atoms interact with each other by transferring or sharing outermost electrons. These outer electrons govern the chemical properties of the element.* *An element is composed of a single type of atom. When elements are listed according to the number of protons, repeating patterns of physical and chemical properties identify families of elements with similar properties. The periodic table is a consequence of the repeating pattern of outermost electrons.* *The physical properties of compounds reflect the nature of the interactions among molecules. These interactions are determined by the structure of the molecule including the constituent atoms.*	• Bonding • Chemical analysis • Chemical bonding • Chemical equations • Elements and compounds • Energy relationships • Industrial chemistry • Metric/Scale • Nomenclature • Physical and chemical properties • Solids, liquids and gases • Solutions and solubility	*Students will:* • Separate a mixture by distillation. • Design an experiment to determine the identity of a substance from its density. • Use a CBL and temperature probe to design an experiment to determine the boiling points of various hydrocarbons. • Develop models of alkanes, alkynes and alkenes • Research and debate the best energy sources. • Build a calorimeter and measure the heat released from a fuel. • Visit a mechanic to discuss and observe energy changes that occur in an automobile as fuel is ignited. • Burn a candle and measure the energy released with a calorimeter. • Separate food dyes through paper chromatography and compare experimental results to the information on the package. • Visit a power plant. • Design an experiment to investigate the relationships between thermal energy and the structure of the hydrocarbon. • Propose sources of heat loss in the internal combustion energy. • Suggest way to improve the reliability of a calorimeter. • Write a feature article informing the reader of alternative sources of energy. (Portfolio) • Write a feature article informing the reader of alternative fuel vehicles. (Portfolio)

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	• Use science to investigate natural hazards and human-induced hazards. *Apply scientific theory and conceptual understandings to solve problems of technological design and examine the interaction between science and technology.* • Investigate chemical reactions and the release or consumption of energy. *Chemical reactions occur all around us and in every cell in our bodies. These reactions may release or consume energy. Rates of chemical reactions vary. Reaction rates depend on concentration, temperature, and properties of reactants. Catalysts speed up chemical reactions.* *Everything tends to become less orderly and organized through time. Thus, in all energy transfers, the overall effect is spread out uniformly. In the operation of mechanical devices, as is all phenomena, the useful energy output is always less than the energy input; the difference usually appears as heat.* • Investigate advances in science and technology that have important and long lasting effects on science and society. *Analyze the role science plays in everyday life and compare different careers in science; recognize that scientific knowledge comes from empirical standards, logical arguments, and skepticism, and is subject to change as new evidence becomes available; and investigate advances in science and technology that have important and long-lasting effects on science and society.* • Identify and refine questions and identify scientific concepts to guide the design of scientific investigations. *Formulate testable hypotheses and demonstrate the logical connections between concepts and guiding a hypothesis and the design of the experiment.*		*(Continued next page)*

	Use equipment, tools, techniques, technology and mathematics to improve scientific investigations and communications. *Use logic and knowledge to develop and revise scientific models.* *Review and analyze scientific investigations and explanations* • Distinguish between types of energy. *All energy can be considered to be either kinetic energy, potential energy, or energy contained by a field (e.g. electric, magnetic, gravitational).* • Investigate factors affecting reaction rate *Chemical reactions occur all around us and in every cell in our bodies. These reactions may release or consume energy. Rates of chemical reactions vary. Reaction rates depend on concentration, temperature, and properties of reactants. Catalysts speed up chemical reactions.* • Examine how energy is transferred and recognize that the total energy in the universe is constant. *The total energy of the universe is constant. Energy can be transferred in many ways, but it can neither be created nor destroyed.*		

Course/Grade **Chem Comm Grade 11** **Unit:** *Earth and Space* **Suggested Length:** **3 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. What evidence can we find that the universe is in the process of continuous change? 2. How are Earth's chemical reservoirs affected by the internal and external sources of energy?	• Use evidence, logic and scientific knowledge • Recognize that scientific knowledge is subject to change. *Recognize that the Earth contains a fixed amount of each stable chemical atom or element.* *Earth is a system containing essentially a fixed amount of each stable chemical atom or element. Each element can exist in several different reservoirs. Each element on Earth moves among reservoirs in the solid Earth, oceans, atmosphere, and organisms as part of geochemical cycles*. • Analyze Earth's chemical reservoirs and recognize that each element can exist in several reservoirs (e.g., carbon in carbon dioxide reservoirs to carbonate reservoirs). • Investigate how Earth's internal and external sources of energy drive geochemical cycles (e.g., carbon moving from carbon dioxide reservoirs to carbonate reservoirs). *Earth is a system containing essentially a fixed amount of each stable chemical atom or element. Each element can exist in several different reservoirs. Each element on Earth moves among reservoirs in the solid Earth, oceans, atmosphere, and organisms as part of geochemical cycles.* • Investigate how Earth's internal and external sources of energy drive geochemical cycles (e.g., carbon moving from carbon dioxide reservoirs to carbonate reservoirs). *Movement of matter between reservoirs is driven by Earth's internal and external sources of energy. These movements are often accompanied by a change in physical and chemical properties of the matter. Carbon, for example, occurs in carbonate rocks such as limestone, in the atmosphere as carbon dioxide, in water as dissolved carbon dioxide, and in all organisms as complex molecules that control the chemistry of life.*	Atomic structure • Chemical analysis • Elements and compounds • Energy relationships • Metrics/Scale • Physical and chemical properties • Solids, liquids and gases	*Students will:* • Investigate factors that contribute to formation of stars and write an article explaining the use of stellar parallax to measure distances to stars. • Investigate components of stars. Observe photographs of spectra from stars. Compare the composition of stars to sun's spectrum. • Create an article explaining how Earth's resources are being depleted while Earth's amount of atoms are essentially the same. • Devise a laboratory exercise to mimic how the Earth's energy drives geochemical cycles (make crystals and relate to water cycle and Earth's minerals). • Visit a planetarium to observe different models of the universe. *(Continued next page)*

	• Describe the formation of the solar system. *The Sun, Earth, and the rest of the solar system formed approximately 4.6 billion years ago from a nebular cloud of dust and gas.* • Describe theories of the formation of the universe (e.g., big bang theory) *The big bang theory and observational measurements that support it place the origin of the universe at a time between 10 and 20 billion years ago, when the universe began in a hot dense state. According to this theory, the universe has been expanding since then.* • Describe the formation of the stars. *Early in the history of the universe, the first atoms to form were mainly hydrogen and helium. Over time, these elements clump together by gravitational attraction to form trillions of stars.* • Examine stars (e.g., energy production, formation of elements.) *Stars have life cycles of birth through death that are analogous to those of living organisms. During their lifetimes, stars generate energy form nuclear fusion reactions that create successively heavier chemical elements. Some stars explode at the end of their lives, and the heavy elements they have created are blasted out into space to form the next generation of stars and planets.* • Examine nuclear structure, nuclear forces, and nuclear reactions (e.g., fission, fusion, radioativity). *The forces that hold the nucleus together, at nuclear distances, are usually stronger that the forces that would make it fly apart. Nuclear reactions convert a fraction of the mass of interacting particles into energy, and they can release much greater amounts of energy than atomic interactions. Fission is the splitting of a large nucleus into smaller pieces. Fusion is the joining of two nuclei at extremely high temperature and pressure. Fusion is the process responsible for the energy of the Sun and other stars.*		

Course/Grade **Chem Comm Grade 11** **Unit:** *Air* **Suggested Length:** **7 Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How is global warming a threat? What can we do about it? 2. How have human activities made an impact on air quality? 3. How would the depletion of the ozone have an impact on life? 4. How does acid rain affect us? 5. How can chemistry help us establish and maintain good air quality? 6. How can we balance the risks and benefits of air quality governmental proposals.	• Identify and refine questions and identify scientific concepts • Use evidence logic and scientific knowledge • Design and conduct different kinds of scientific investigations. *Formulate testable hypotheses and demonstrate the logical connections between concepts and guiding a hypothesis and the design of the experiment.* *Use equipment, tools, techniques, technology and mathematics to improve scientific investigations and communications.* *Use logic and knowledge to develop and revise scientific models.* *Review and analyze scientific investigations and explanations.* • Investigate how science can be used to solve environmental problems. *Explore the impact of scientific knowledge and discoveries on personal and community health; recognize how science influences human population growth, use science to analyze the use of natural resources by an increasing human population; investigate how science can be used to solve environmental quality problems, use science t investigate natural and human-induced hazards; and analyze how science and technology are necessary but not sufficient for solving local, national, and global issues.*	• Chemical analysis • Chemical bonding • Elements and compounds • Energy relationships • Formula and equation writing • Gas laws • Industrial chemistry • Metrics/Scale • Mole concept • Nomenclature • Physical and chemical properties Reaction rates • Solids, liquids and gases • Solutions • Stoichiometry	*Students will:* • Demonstrate the following characteristics of air; air is matter, air exerts pressure, air can have an odor, air can burn. • Use CBL's to determine the relationship among temperature and volume and pressure and volume. • Prepare a gas that is a component of air i.e. Oxygen, Carbon dioxide. • Prepare a graph of altitude vs. temp erature and pressure vs. altitude using a graphing calculator. Analyze the results. • Write a letter for a scuba diving magazine to discuss the precautions a diver should take when diving. Incorporate the gas laws. (Portfolio) • Devise a greenhouse and collect temperature readings. Relate the concept to the greenhouse effect and explain the effects of global warming. • Devise a plan of action to halt the increase of carbon dioxide in the atmosphere. • Use a spectroscope to determine the energies of different forms of electromagnetic radiation. *(Continued next page)*

	• Recognize that scientific knowledge is subject to change • Analyze the role science plays in everyday life and compare science careers *Analyze the role science plays in everyday life and compare different careers in science; recognize that scientific knowledge comes from empirical standards, logical arguments, and skepticism, and is subject to change as new evidence becomes available; and investigate advances in science and technology that have important and long-lasting effects on science and society.*		

Course/Grade **Chem Comm Grade 11** **Unit:** *Nuclear* **Suggested Length:** **Weeks**

Essential Questions	Connections to Program of Studies And *Core Content*	Content	Suggested Activities
1. How do radioactive atoms differ from non-radioactive atoms? 2. What role will nuclear energy play as fossil fuels become scarce? 3. How do the use of nuclear energy and the risk of emission outweigh the benefits? 4. How can we become informed decision makers about environmental issues?	• Examine nuclear structure, nuclear forces, and nuclear reactions *The atom's nucleus is composed of protons and neutrons that are much more massive than electrons. When an element has atoms that differ in the number of neutrons, these atoms are called different isotopes of the element.* *The forces that hold the nucleus together, at nuclear distances, are usually stronger that the forces that would make it fly apart. Nuclear reactions convert a fraction of the mass of interacting particles into energy, and they can release much greater amounts of energy than atomic interactions. Fission is the splitting of a large nucleus into smaller pieces. Fusion is the joining of two nuclei at extremely high temperature and pressure. Fusion is the process responsible for the energy of the Sun and other stars.* • Examine how energy is transferred and recognize that the total energy in the universe is constant. *The total energy of the universe is constant. Energy can be transferred in many ways, but it can neither be created nor destroyed.* • Explore the impact of scientific knowledge and discoveries on personal and community health *Explore the impact of scientific knowledge and discoveries on personal and community health; recognize how science influences human population growth, use science to analyze the use of natural resources by an increasing human population; investigate how science can be used to solve environmental quality problems, use science t investigate natural and human-induced hazards; and analyze how science and technology are necessary but not sufficient for solving local, national, and global issues.*	• Atomic structure • Chemical analysis Chemistry • Elements and compounds • Energy relationships • Formula and equation writing • Industrial • Metric/Scale • Nomenclature • Physical and chemical properties • Reaction rate • Solids, liquids and gases • Solutions	*Students will:* • Research why irradiated food has been banned from some states. (Portfolio) • Prepare a summary chart of isotopes. Note the relationship between protons and neutrons. • Use a set of 20 pennies to discover the number of isotopes for "pennium". • Use a Geiger counter to measure the rate of radiation from a radioactive source. Compare the rate of radiation with different types of shields. • Devise a lab to show the inverse square relationship of intensity to dis tance. • Write a portfolio piece describing the experiences of a patient undergoing chemotherapy and how radiation changes one's lifestyle. (Portfolio) • Develop an activity to demonstrate half life • Report on the use of radioactive isotopes for dating artifacts and rocks, and for judging the authenticity of paintings. (Portfolio) • Develop a brochure to discuss the pros and cons of nuclear energy as an alternative source of energy. *(Continued next page)*

	• Use science to investigate natural hazards and human induced hazards *Apply scientific theory and conceptual understandings to solve problems of technological design and examine the interaction between science and technology.* • Investigate advances in science and technology that important and long-lasting effects on science and society. *Explore the impact of scientific knowledge and discoveries on personal and community health; recognize how science influences human population growth, use science to analyze the use of natural resources by an increasing human population; investigate how science can be used to solve environmental quality problems, use science t investigate natural and human-induced hazards; and analyze how science and technology are necessary but not sufficient for solving local, national, and global issues.* • Recognize that scientific knowledge is subject to change. *Analyze the role science plays in everyday life and compare different careers in science; recognize that scientific knowledge comes from empirical standards, logical arguments, and skepticism, and is subject to change as new evidence becomes available; and investigate advances in science and technology that have important and long-lasting effects on science and society.* • Examine how everything tends to become less orderly over time. *All energy can be considered to be either kinetic energy, potential energy, or energy contained by a field (e.g. electric, magnetic, gravitational).* *Heat is the manifestation of the random motion and vibrations of atoms, molecules, and ions. The greater the atomic or molecular motion, the higher the temperature.*		*(Continued next page)*

	The universal becomes less orderly and less organized over time. Thus, the overall effect is that the energy is spread out uniformly. For example, in the operation of mechanical systems, the useful energy output is always less than the energy input; the difference appears as heat. • Analyze atomic structure and electric forces *The atom's nucleus is composed of protons and neutrons that are much more massive than electrons. When an element has atoms that differ in the number of neutrons, these atoms are called different isotopes of the element.*		